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UTILIZATION OF ELM.

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IMPORTANCE.

Elm is one of the important commercial woods of the United States. It is important, however, not so much because of the amount consumed annually, for 8 or 10 hardwoods and an even greater number of softwoods are used in larger quantities, as because it has qualities which make it especially desirable for bent work and for uses in which it is subjected to shock or impact and rough usage in general. It is particularly suited for slack-cooperage stock, certain parts of vehicles, baskets, and crating.

COMMERCIAL SPECIES.

The following five species produce the supply of elm wood in the United States: White elm (*Ulmus americana*), slippery elm (*Ulmus fulva*), cork elm (*Ulmus racemosa*), wing elm (*Ulmus alata*), and cedar elm (*Ulmus crassifolia*). The proportion which each contributes to the lumber industry is not known, since they are often mixed together and are all generally listed as "elm" in reports of manufacturers of elm lumber and elm products.

White elm is by far the most important species in the production of elm wood. It often goes under the name "gray elm" in the Lake States, and in foreign countries is called "American elm" and "Canadian elm."

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Slippery elm is so called from its thick mucilaginous inner bark, which distinguishes it from the other elms. The name "red elm" is also applied to it. This species is second in importance. Since the wood is quite similar to white elm and the tree is found in practically the same regions, it is generally marketed with white elm under the same name.

Cork elm, which takes its name from the corky excrescences or growths on the twigs, is also an important commercial species. It is called "rock elm" in the trade. This name is also applied to hard, dense, rapid-growth wood of other species; in fact, very dense wood of any species of elm is called rock elm, and the softer, more porous wood is called "soft elm." Very porous elm wood is often termed "water elm" or "swamp elm."

Wing elm takes its name from the corky growths on the twigs similar to those on cork elm, which in this species are thin and wing-like. Wing elm is of small importance commercially.

Cedar elm, often called "red elm" and in Arkansas "basket elm," is utilized only in a small way, and much of it is not large enough to manufacture into lumber.

CHARACTERISTICS OF THE WOOD.

GENERAL APPEARANCE.

The heartwood of elm is light brown, often tinged with red; the sapwood is lighter. The wood has a fairly distinct and somewhat attractive figure, which is due to bands of pores occurring at the beginning of each annual layer of growth. This figure is inconspicuous in rock elm because of the smaller size of the pores. The figure varies considerably with the width of annual rings, wood with annual growth layers moderately wide usually yielding the most attractive material. Radial cuts do not give the quartered effect of oak because of the comparatively narrow pith rays. Tangential surfaces present the most pleasing appearance.

MECHANICAL PROPERTIES.

The wood of all species of elm is in general heavy, hard, strong, and has in a high degree the ability to withstand shock. It is difficult to split, except slippery elm. It shrinks moderately in seasoning, is one of the best woods for bending, and takes a good polish. Table 1 gives the properties of the three principal elm woods expressed in comparative terms. Table 2 shows the results of tests to determine the mechanical properties of the elms, with data for several hickories included for comparison. The table also gives the values of these woods compared to oak. Similar data for wing and cedar elm are not available. Table 3 gives, for different elms, the average com-

puted weight of 1-inch lumber, the weight of a cord of wood, and the weight of logs per thousand board feet as scaled by the Doyle and Scribner log rules. In this table the cord is calculated as being composed of 90 cubic feet of solid wood. The weight adopted by the Hardwood Manufacturers' Association of the United States for rough white elm lumber 1 inch thick is 3,200 pounds per thousand board feet. Comparison of this with the figures given in Table 3 shows that the association weight is for lumber in a partially air-dry condition. A weight of 3,200 pounds per thousand board feet corresponds to a moisture content of about 16.4 per cent, and air-dry wood usually varies between 12 and 15 per cent. Similarly, the weight adopted by the same association for rough cork elm lumber is 3,800 pounds per thousand, which is somewhat higher than that given in Table 3.

In general, cork elm has higher strength values than white elm, and slippery elm has values between the two. Both white and slippery elm have lower strength values than white oak (excepting the shock-resisting ability of slippery elm), particularly in compression perpendicular to grain and hardness. The values for cork elm do not vary greatly from those for white oak, except in shock-resisting ability, which is much higher in cork elm. The elms all rank lower than the hickories in mechanical properties. A good quality of cork-elm wood should, however, make a fairly satisfactory substitute for hickory where these properties are of first consideration, as for long heavy handles, the running-gear parts of light vehicles, eveners, etc.

Elm is a fairly durable wood. The estimated average life of untreated elm lumber in the United States in situations exposed to the weather is from 6 to 8 years. The durability of any individual stick, however, may vary from this figure, depending on the quality of the wood and the moisture conditions. White elm is said to be somewhat less durable in contact with the soil than slippery elm. It is highly desirable to treat elm where it is to be used in exposed situations. By proper treatment with creosote its life may be lengthened to 20 or more years.

TABLE 1.—*Properties of elm woods expressed in comparative terms.*

Property.	White elm.	Slippery elm.	Cork elm.
Weight	Moderately heavy	Moderately heavy	Heavy.
Shrinkage	Moderate	Moderate	Moderate.
Strength	Moderately strong	Moderately strong	Strong.
Stiffness	Moderately stiff	Moderately stiff	Moderately stiff.
Hardness	Moderately hard	Moderately hard	Hard.
Shock-resisting ability	Good	Good	Excellent.
Cleavability	Poor	do	Poor.

TABLE 2.—*Average mechanical properties of elm woods, actual and comparative.*

[Based on tests of small clear specimens in a green condition.]

Common and botanical name.	Locality where grown.	Weight per cubic foot.			Shrinkage from green to oven-dry condition.			Strength in bending (per square foot).	
		Green.	Air-dry.	Kiln-dry.	In volume.	Radial.	Tangential.	Modulus of rupture.	Relative strength compared to oak. (oak=100).
		Pounds.	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	*Per cent.*	*Pounds.*	
White elm (*Ulmus americana*)	Pennsylvania and Wisconsin	52	35	33	14.4	4.2	9.5	6,900	83
Slippery elm (*Ulmus fulva*)	Indiana and Wisconsin	56	38	37	13.8	4.9	8.9	8,000	96
Cork elm (*Ulmus racemosa*)	Wisconsin	54	45	43	14.1	4.8	8.1	9,500	114
Shagbark hickory (*Carya ovata*)	Ohio, Mississippi, Pennsylvania, West Virginia.	64	52	50	16.7	7.0	10.5	11,000	133
Pignut hickory (*Carya glabra*)	Ohio, Mississippi, Pennsylvania, West Virginia.	64	55	53	17.9	7.2	11.5	11,700	141
Mockernut hickory (*Carya alba*)	Pennsylvania, Mississippi, West Virginia.	64	53	50	17.9	7.8	11.0	11,110	134

TABLE 2.—*Average mechanical properties of elm woods, actual and comparative*—Continued.

Common and botanical name.	Locality where grown.	Strength in compression parallel to grain (per square inch).		Strength in compression perpendicular to grain (per square inch).		Stiffness per square inch.		Side hardness.		Shock-resisting ability (per cubic inch).	
		Maximum crushing strength.	Relative strength compared to oak(oak=100).	Fiber stress at elastic limit.	Relative strength compared to oak(oak=100).	Modulus of elasticity in bending.	Relative stiffness compared to oak(oak=100).	Load required to embed a 0.44-inch ball one-half its diameter.	Relative hardness compared to oak(oak=100).	Work to maximum load in bending.	Shock-resisting ability compared to oak(oak=100).
		Pounds.		*Pounds.*		*1,000 lbs.*		*Pounds.*		*Inch-lbs.*	
White elm (*Ulmus americana*)	Pennsylvania and Wisconsin	2,860	80	390	47	1,030	82	530	50	11.0	96
Slippery elm (*Ulmus fulva*)	Indiana and Wisconsin	3,310	93	510	61	1,230	98	660	62	15.4	134
Cork elm (*Ulmus racemosa*)	Wisconsin	3,770	106	740	89	1,200	96	970	92	19.7	171
Shagbark hickory (*Carya ovata*)	Ohio, Mississippi, Pennsylvania, West Virginia.	4,580	129	1,000	120	1,570	125	.....	.....	23.7	206
Pignut hickory (*Carya glabra*)	Ohio, Mississippi, Pennsylvania, West Virginia.	4,810	135	1,140	137	1,650	132	.....	.....	31.7	276
Mockernut hickory (*Carya alba*)	Pennsylvania, Mississippi, West Virginia.	4,480	126	1,000	120	1,570	125	.....	.....	26.1	226

TABLE 3.—*Computed weights of elm in different forms.*

Kind of elm.	1,000 feet b. m. of 1-inch lumber.	Cord (90 cubic feet solid wood).	1,000 board feet of logs.							
			Doyle log rule: diameter of logs (inches)—				Scribner log rule: diameter of logs (inches)—			
			6	12	18	24	6	12	18	24
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
White elm, green....	4,300	4,700	55,600	12,000	8,400	7,100	12,400	9,700	7,700	7,000
White elm, air-dry..	2,900	3,200	37,400	8,100	5,600	4,800	8,300	6,500	5,200	4,700
Slippery elm, green..	4,700	5,000	59,900	12,900	9,000	7,600	13,300	10,500	8,300	7,600
Slippery elm, air-dry	3,200	3,400	40,600	8,800	6,100	5,200	9,000	7,100	5,600	5,100
Cork elm, green.....	4,500	4,900	57,700	12,400	8,700	7,500	12,800	10,100	8,000	7,300
Cork elm, air-dry....	3,700	4,000	48,100	10,400	7,200	6,100	10,700	8,400	6,700	6,000

STRUCTURE OF THE WOOD.

Elm belongs to the group of ring porous woods, the beginning of each ring or layer of growth containing a band of more or less conspicuous pores. Throughout the rest of the growth ring there are smaller pores arranged in more or less continuous wavy lines. These wavy lines are of assistance in distinguishing elm from other ring porous woods, such as the hickories, ashes, oaks, and chestnut. The medullary rays are narrow and not visible to the unaided eye. In hackberry and sugarberry, which resemble the elms in structure, the rays are visible. The number, size, and arrangement of large and small pores serve to distinguish the wood of the different species. Slippery elm (Pl. I) has several rows of large pores, and the small pores are in somewhat interrupted wavy lines. In the other species of elm there is a single row of pores at the beginning of each annual ring. In cork elm (Pl. II) these pores are much smaller than in slippery and white elm (Pl. III), and the small pores are in very distinct, fairly continuous, wavy bands.

The following key may be used to distinguish the three principal elm species.[1] The characteristics mentioned may be seen on a smoothly cut cross section. A hand lens is an efficient aid in applying the key.

Pores of late wood arranged tangentially in conspicuous wavy, usually continuous, bands, the pores minute.

A. Rays very distinct to the unaided eye; heartwood indistinct, color yellowish.
HACKBERRY, *Celtis occidentalis.*
SUGARBERRY, *Celtis mississippiensis.*

B. Rays barely visible to the unaided eye; heartwood distinct, color reddish brown.
1. Pores of early wood in a band 3 or more pores wide.
RED OR SLIPPERY ELM, *Ulmus pubescens.*

[1] Wing elm is similar in appearance to cork elm, except that the bands of small pores are about as wide as the intervening spaces. Cedar elm may be distinguished by the very indistinct row of pores at the beginning of the annual ring.

2. Pores of early wood in a single tangential row.
   a. Pores of early wood comparatively large, forming a continuous row; bands of small pores numerous, usually about as wide as the intervening bands of dense tissue. Wood moderately hard and heavy. White Elm, *Ulmus americana*.
   b. Pores of early wood minute, individual pores scarcely visible to the unaided eye, often rather widely separated; bands of small pores not so numerous as in white elm, narrower than the intervening bands of dense tissue (except in narrow rings). Wood very hard, heavy, dense.....Cork or Rock Elm, *Ulmus racemosa*.

SUPPLY AND DEMAND.

RANGE AND SIZE OF SPECIES.

The botanical range of white elm includes nearly all of the region east of the Rocky Mountains (fig. 1). The area of principal com-

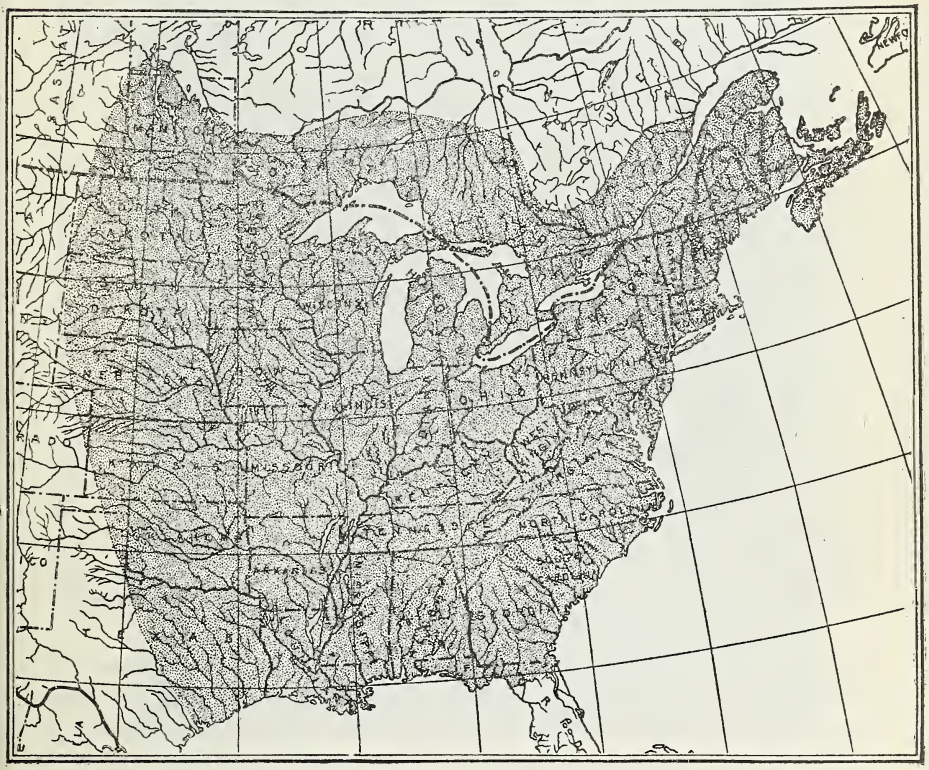


Fig. 1.—Distribution of white elm (*Ulmus americana*).

mercial importance, however, is southern New England, the Great Lakes States, and the southern Mississippi Valley. White elm is the largest of the elms, frequently attaining a height of from 100 to 120 feet, with a buttressed trunk from 6 to 10 feet in diameter. The range of slippery elm (fig. 2) is nearly as great as that of white elm and includes practically the same territory. Slippery elm is not

abundant, however, in any part of its range; the trees are scattered throughout the forest and the average size is small. The slippery elm tree grows to a height of from 60 to 70 feet, with a trunk rarely more than 2 to 2½ feet in diameter. The range of cork elm is much more limited than that of white and slippery elm (fig. 3). It does not extend farther south than Tennessee, and throughout a large part of the region of its distribution it is not important commercially. The tree attains a height of from 80 to 100 feet and a trunk diameter of from 3 to 4 feet. Wing elm grows in southeastern United States (fig. 4). It is commercially important in the western part of its

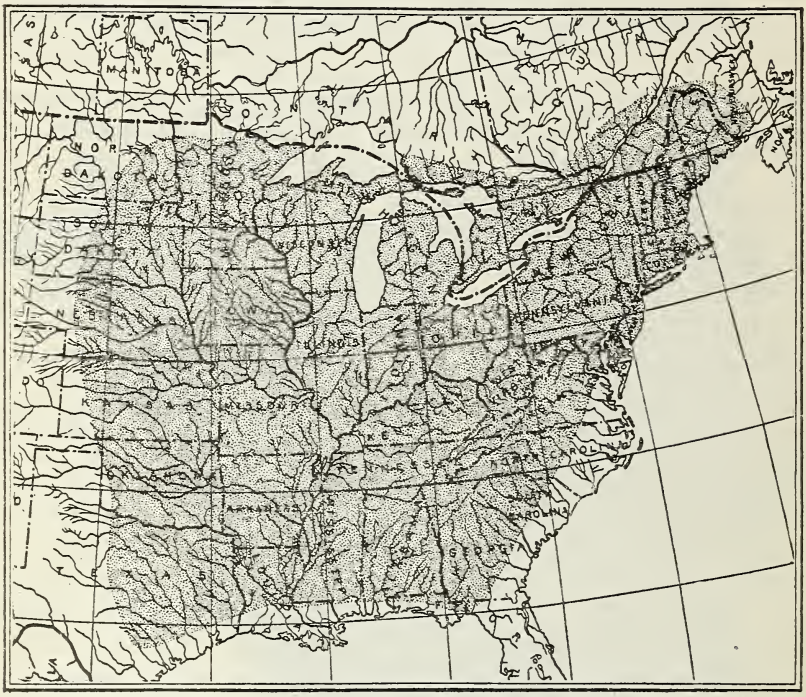
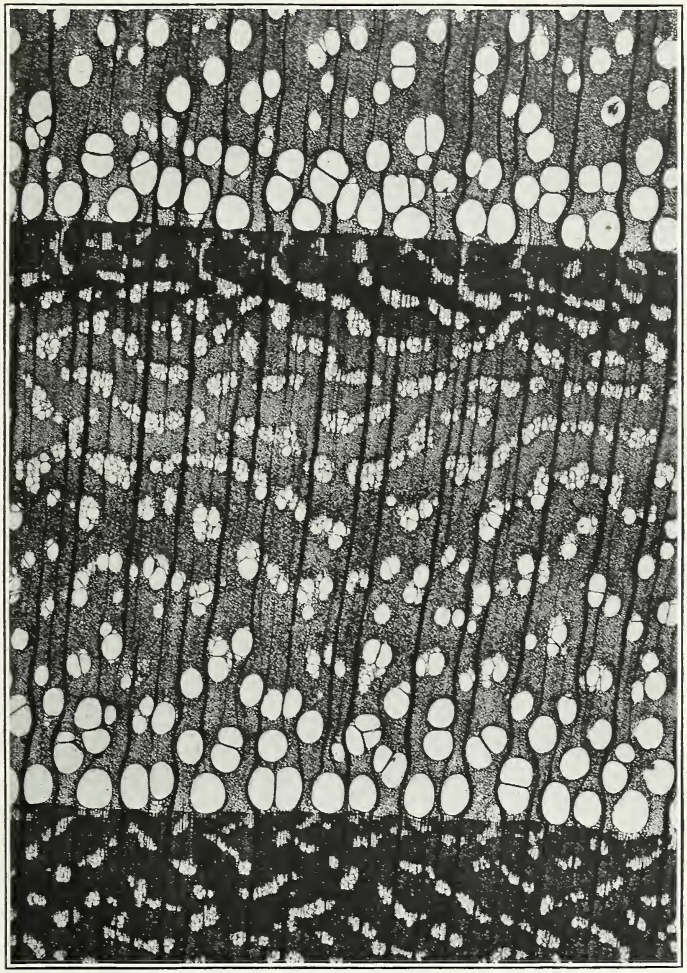


FIG. 2.—Distribution of slippery elm (*Ulmus fulva*).

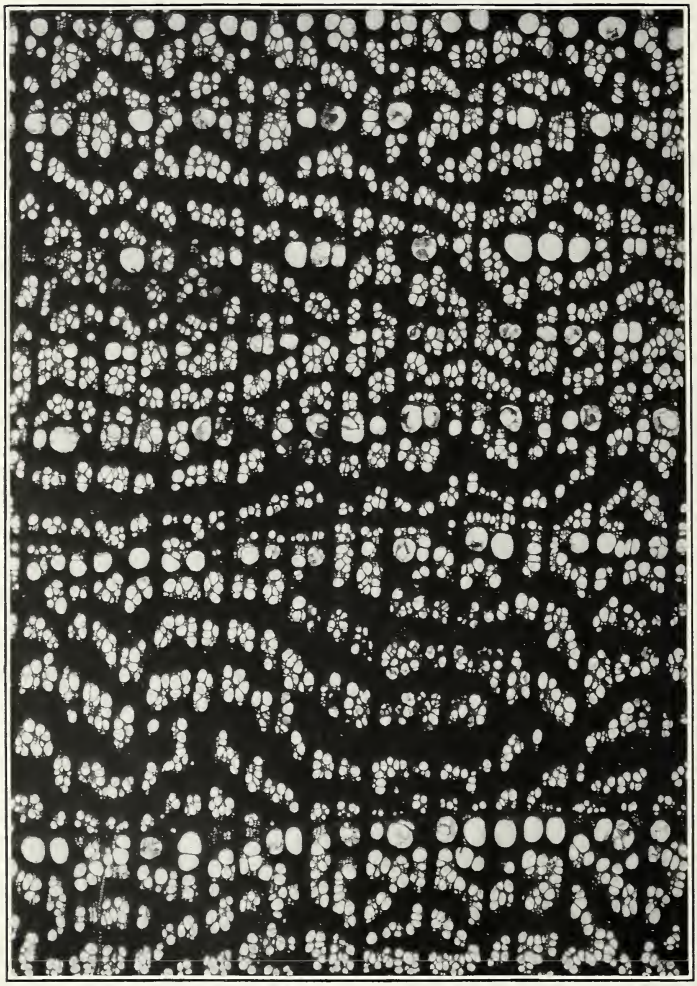
range, chiefly in Missouri, Arkansas, and southeastern Texas. It rarely has a greater height than 60 feet or greater trunk diameter than 2 feet. Cedar elm occurs from southern Arkansas to Mississippi and in Texas. It reaches its best development in southern Arkansas and northeastern Texas, where it grows to a maximum height of 90 feet and a maximum trunk diameter of about 3 feet. It is fairly abundant in some localities in Texas.

SUPPLY.

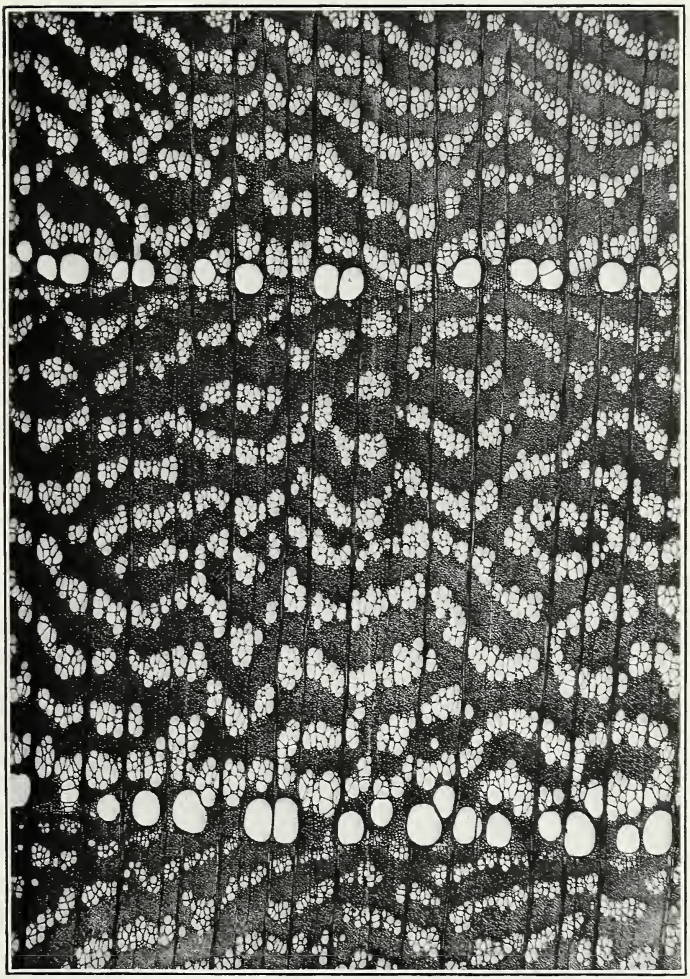
The principal supply of elm has come from the States bordering on the Great Lakes, but logging and agriculture have greatly reduced the stand. Wisconsin and Michigan still furnish a large supply of



TRANSVERSE SECTION OF THE WOOD OF SLIPPERY ELM; MAGNIFIED 20 DIAMETERS.



TRANSVERSE SECTION OF THE WOOD OF CORK ELM; MAGNIFIED 20 DIAMETERS.



TRANSVERSE SECTION OF THE WOOD OF WHITE ELM; MAGNIFIED 20 DIAMETERS.

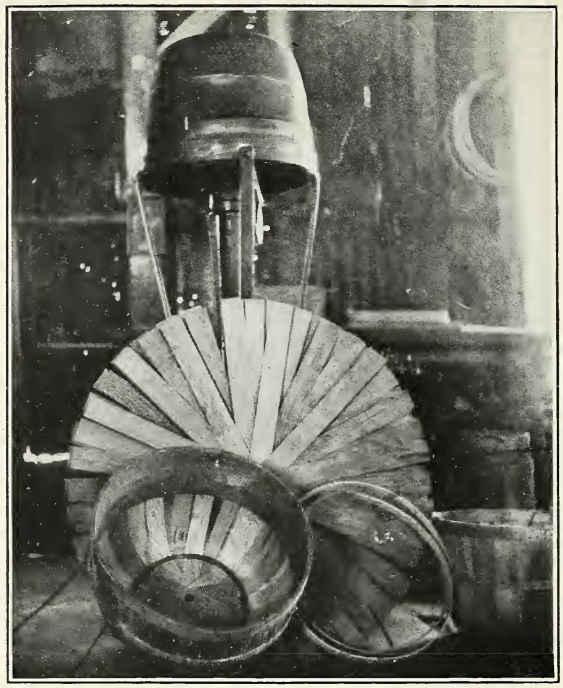


FIG. 1.—SHOWING MACHINE FOR MAKING BUSHEL BASKETS, SPLINTS IN CIRCULAR FORM READY FOR BENDING ON MACHINE, HOOP AND FINISHED BASKETS. GRAIN BASKET IN FRONT.

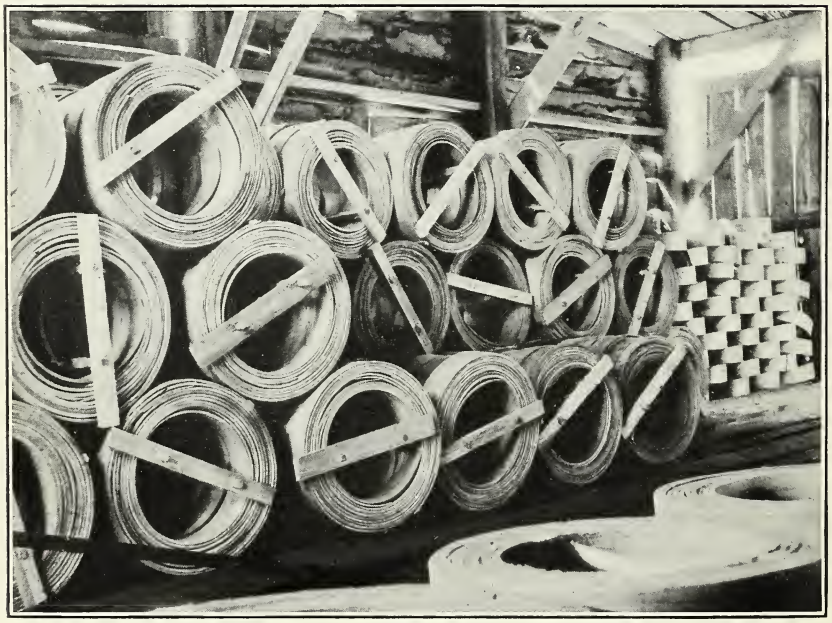


FIG. 2.—ELM RIMS USED FOR CHEESE BOXES AND ROUND MEASURES, READY FOR SHIPMENT.

the three important species. There is yet considerable standing timber of white elm in these two States, and one of the principal sources of supply is the northern third of the southern peninsula of Michigan. A large part of the total supply of cork elm also comes from the southern parts of Wisconsin and Michigan. This species of elm is being exhausted much more rapidly than the others.

So much of the forest timber has been removed in the Great Lakes region that factories requiring a large supply of cheap elm timber have in many cases been forced to discontinue operations there. Future supplies in this region must come largely from woodlots and small timber holdings.

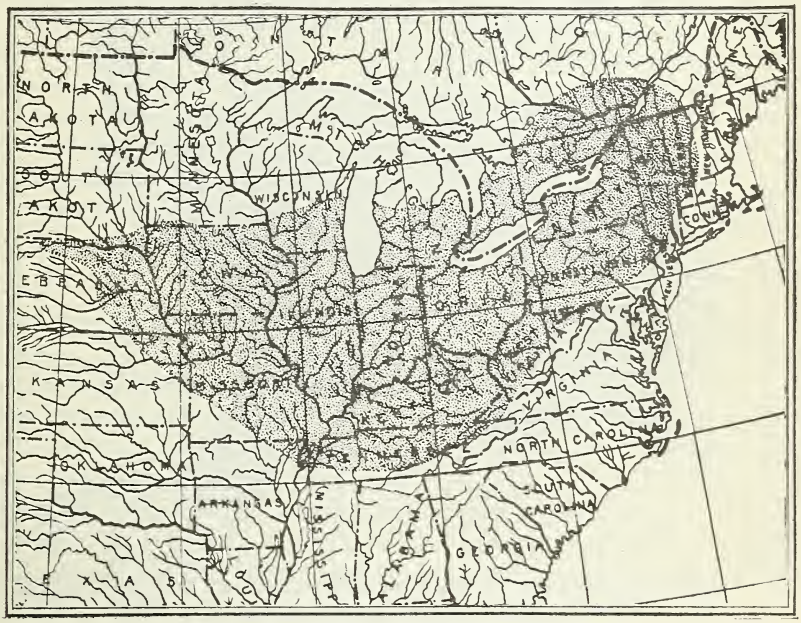


FIG. 3.—Distribution of cork elm (*Ulmus racemosa*).

There is considerable standing white elm in the southern Mississippi Valley region, where it has only recently been exploited to any great extent. Arkansas is now one of the principal sources of white-elm timber, but factories in that State which demand large quantities of elm in the log are already complaining that they have considerable trouble in securing a sufficient supply. Many of such factories have removed farther south to Mississippi and Louisiana. These two States have been yielding increasing amounts of elm saw timber each year and must be depended on for a large part of such timber in the future as well as a supply in log form for elm-using factories.

The elm timber of the southern Mississippi Valley region, in general, seems to differ in quality from that obtained in the Great

Lakes region. The southern elm is darker, usually reddish, and often variable in color, in contrast to the more uniform and lighter-colored northern elm. The darker and more variable color is not sought in the manufacture of some products, such as high-grade baskets, in which a white, clean appearance is desired. The southern elm also seems to be more defective, so that there is greater waste in manufacture. It has the reputation of being more brash and less strong than the northern elm, although probably considerable variation in these qualities would be found in material from any one region.

The stand of privately owned elm timber in Michigan, Wisconsin, and Minnesota was estimated by the Bureau of Corporations in

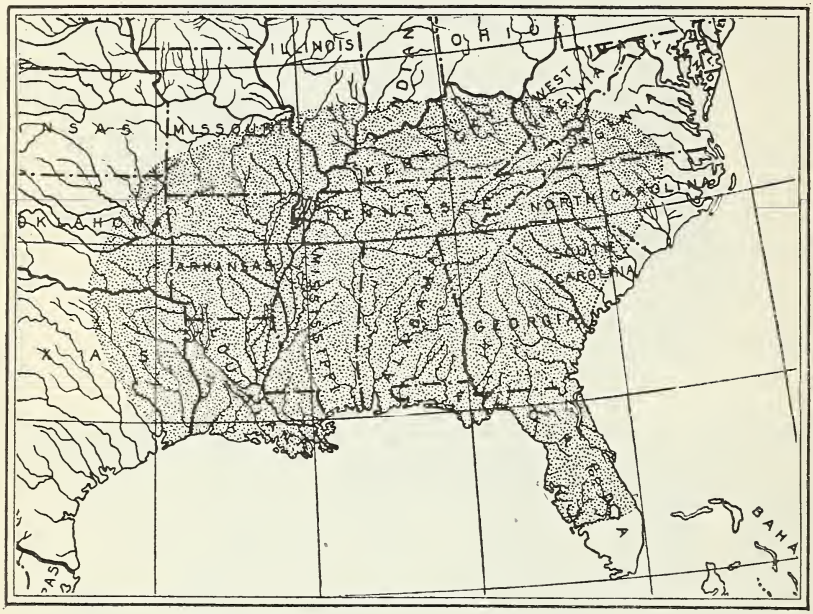


FIG. 4.—Distribution of wing elm (*Ulmus alata*).

1907 to 1909 [1] to be 3,700,000,000 [2] board feet. These three States yield nearly one-half the elm saw timber produced in the United States. Assuming that the annual cut throughout the country is in proportion to the stand, it follows that there is a total stand of approximately seven and one-half billion feet. This would furnish a supply for approximately 30 years at the present rate of cutting. This does not take into account the manufacture of products other than elm lumber, such as slack cooperage, which are made directly from the log. Economic conditions in manufacture change so largely from year to year that any estimate regarding the probable exhaustion of the supply is unsafe. It is estimated that about three-fourths of the

[1] Report on the Lumber Industry, Part I, Standing Timber, 1913, page 78.
[2] Michigan, 2,100,000,000; Wisconsin, 1,500,000,000; Minnesota, 100,000,000.

total amount of elm used is white elm, and it is probable that the proportion of the stand does not differ greatly from this figure. This would place the stand of white elm at about five and one-half billion feet.

No estimate can be made of the stand of slippery elm. It is cut in the same region as white elm. The trees are scattered throughout the forest, and the lumber is manufactured and placed on the market mixed with white elm. The stand of cork elm is likewise unknown. On account of its limited distribution and the heavy demand upon the supply it is rapidly diminishing.

The supply of wing elm and cedar elm is small, and these species are of commercial importance only in small restricted areas. Wing elm is evidently fairly abundant in certain locations, since an annual use of approximately a million feet has been reported in Texas, and probably more than that is used in each of the States of Missouri, Arkansas, Mississippi, and Louisiana. The stand of cedar elm is even less than that of wing elm, and it is used for local manufacturing purposes only. The wing and cedar elm trees are not usually larger in diameter than 2 feet, and the cedar elm is inclined to become shrubby in situations unfavorable for its growth.

LUMBER CUT.

The present output of elm lumber is about 240,000,000 board feet annually. This puts elm twentieth in rank among all woods and tenth among hardwoods in point of lumber production.

For the past 10 years elm has constituted between 3 and 3½ per cent of the total amount of hardwood lumber manufactured in the United States and between 1 and 2 per cent of the total of all woods. The amount of lumber cut does not represent the entire amount of wood used, since many woods are utilized by different industries largely in the form of the log or billet, and the amount so used is not reported as lumber. This is true to a certain extent of elm. Table 4 gives the production of elm lumber for different years by States. According to these figures, the production of elm lumber is decreasing rapidly. Nearly 347½ million feet were reported in 1909, about 262 million feet in 1912, and a little less than 178 million feet in 1915. However, there has not been a reduction in cut to the extent indicated by these figures, since the returns for years subsequent to 1909 are incomplete. This is shown by the computed total cut for 1916 of 240,000,000 feet. Table 5 shows the number of mills reporting elm for different years. Wisconsin and Michigan have been the leading States in the production of elm lumber for the last decade. There has been a decided decrease in production in New York, Ohio, Indiana, Illinois, Iowa, and Missouri. Arkansas, Louisiana, and Mississippi, on the other hand, have been producing increasing amounts. In Kentucky and Tennessee the production has been rather constant.

TABLE 4.—*Output of elm lumber, by States, in 1899 and from 1904 to 1915, inclusive, average value of the product f. o. b. mills, and number of mills reporting.*

State.	1899	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
Total number of mills reporting	31,833	[1] 18,277	11,666	22,398	28,850	31,231	[2] 46,584	[1] 31,934	[1] 28,107	[1] 29,005	[1] 21,668	[1] 27,506	[1] 16,815
Total number of mills cutting elm	.....	.....	1,937	.....	[3] 3,400	[3] 4,771	8,028	5,785	5,159	5,573	3,034	2,665	2,730
Average value per 1,000 board feet f. o. b. mill	$11.47	$14.45	.....	$18.08	$18.45	$18.40	$17.52	$18.67	$17.13	$16.87	.....	.....	$16.98
	1,000 bd. ft.	*1,000 bd. ft.*	*1,000 bd. ft.*	*1,000 bd. ft.*	*1,000 bd. ft.*	*1,000 bd. ft.*	*1,000 bd. ft.*	*1,000 bd. ft.*	*1,000 bd. ft.*	*1,000 bd. ft.*	*1,000 bd. ft.*	*1,000 bd. ft.*	*1,000 bd. ft.*
Total cut of elm	456,731	258,330	227,038	224,795	260,579	273,845	347,456	265,107	236,108	262,141	214,532	214,294	[4] 177,748
Wisconsin	76,897	52,895	70,327	42,136	57,397	63,425	75,472	68,037	55,193	50,608	52,307	51,640	42,534
Michigan	109,443	78,255	57,305	29,261	33,797	48,441	58,321	53,050	47,991	52,757	45,415	41,790	35,598
Arkansas	3,228	15,876	9,321	11,532	11,925	8,237	13,056	11,470	12,228	13,172	11,815	16,141	17,055
Indiana	74,669	40,503	24,911	34,580	37,984	25,740	40,364	25,872	19,974	27,463	20,624	22,507	15,129
Ohio	93,413	27,089	22,464	29,058	27,970	27,100	33,182	24,199	25,927	28,968	19,345	14,411	13,815
New York	16,157	4,611	7,425	19,855	25,427	26,609	16,280	10,112	12,462	13,684	11,016	12,776	9,435
Missouri	28,124	9,345	8,425	15,251	17,215	18,695	27,913	19,043	15,318	22,279	13,648	16,738	8,817
Tennessee	3,493	3,043	3,369	4,513	5,727	9,477	10,688	7,225	6,108	6,176	9,219	13,764	7,825
Louisiana	83	.....	7	302	696	308	1,341	1,703	1,791	2,100	2,860	3,752	6,031
Mississippi	.....	1,030	2,037	3,703	2,692	4,808	6,090	7,356	3,636	5,759	6,750	4,646	4,857
Minnesota	8,354	2,652	5,251	2,555	6,192	8,956	14,645	9,738	9,833	12,245	5,752	4,259	3,754
Illinois	16,667	8,778	7,584	12,699	12,585	11,419	12,102	6,549	5,097	6,874	3,656	5,375	2,780
Kentucky	3,213	3,456	2,351	3,994	5,277	4,939	10,130	4,551	3,264	3,797	3,760	1,178	2,358
Iowa	13,873	2,516	1,503	4,234	4,158	4,955	11,710	6,648	6,309	4,981	3,263	646	2,161
Pennsylvania	2,619	5,754	2,323	5,635	5,796	2,867	4,954	2,224	3,192	2,994	830	1,188	1,155
Vermont	628	1,442	947	1,759	1,387	1,341	1,766	1,489	1,575	1,348	483	568	1,003
Maine	68	.....	421	623	513	701	910	554	599	407	85	106	517
Texas	2,018	.....	47	20	478	694	703	431	588	852	792	450	513
Oklahoma	230	60	140	141	1,043	2,592	2,140	1,777	1,776	1,304	363	681	434
North Carolina	.....	.....	52	187	70	75	404	164	53	52	760	10	314
West Virginia	.....	255	116	308	458	481	881	546	325	165	488	43	291
Georgia	.....	35	110	144	93	354	274	330	212	203	306	422	271
Alabama	568	.....	32	429	156	284	1,082	536	664	2,217	179	571	247
New Jersey	22	50	160	94	102	48	102	138	150	70	35	45	244
South Carolina	.....	.....	17	51	8	21	19	168	140	186	422	306	234
Virginia	2	.....	20	426	151	105	244	138	223	163	22	75	148
Connecticut	3	.....	107	521	257	306	367	215	192	152	47	45	69
Massachusetts	.....	.....	72	322	281	395	366	200	295	262	56	58	67
New Hampshire	.....	.....	50	290	447	286	242	385	844	350	8	35	54
Maryland	.....	.....	61	58	190	105	974	87	32	177	35	36	38
Rhode Island	.....	.....	.....	74	57	6	6	10	5	15	.....	.....	.....
Florida	.....	.....	3	.....	.....	.....	5	.....	.....	20	.....	.....	.....
Delaware	.....	.....	.....	.....	.....	.....	3	5	.....	.....	.....	5	.....
Utah	.....	.....	.....	.....	.....	.....	.....	.....	22	.....	.....	.....	.....
South Dakota	.....	.....	.....	.....	.....	.....	.....	.....	5	.....	.....	.....	.....
All other States (Kansas and Nebraska)	2,959	745	80	40	50	75	720	157	85	341	191	35	.....

[1] Mills cutting under 50,000 feet excluded.
[2] Includes 4,543 mills cutting less than 50,000 feet, and all cooperage, veneer, millwork, box, furniture, and other factories cutting any lumber in 1909.
[3] Not including New York.
[4] Computed total production 210,000,000.

TABLE 5.—*Number of mills reporting lumber cut of elm in the different States.*

State.	1905	1907	1908	1909	1910	1911	1912	1913	1914	1915
Total	1,937	[1] 3,400	[1] 4,771	8,028	5,785	5,159	5,573	3,034	2,665	2,730
Wisconsin	254	199	569	680	545	492	502	315	265	264
Michigan	254	175	504	700	567	515	488	305	208	217
Arkansas	54	136	107	220	126	100	119	69	68	72
Indiana	299	605	666	914	648	537	597	307	329	293
Ohio	316	520	620	920	650	575	703	322	301	319
New York	.....	([2])	([2])	850	605	696	684	758	640	570
Missouri	72	283	388	810	527	445	462	243	175	135
Tennessee	.....	161	236	400	293	220	268	124	169	116
Louisiana	.....	*a*	11	28	21	18	24	22	30	26
Mississippi	.....	*a*	74	86	77	57	64	43	51	49
Minnesota	.....	66	195	298	236	211	222	35	61	60
Illinois	.....	296	320	436	281	231	284	126	86	63
Kentucky	.....	212	245	395	286	218	252	93	33	79
Iowa	.....	*a*	89	282	146	137	131	82	21	64
Pennsylvania	.....	221	236	308	204	197	233	48	78	119
Vermont	.....	*a*	119	134	130	125	130	34	43	77
Maine	.....	*a*	78	80	64	60	60	13	10	53
Texas	.....	*a*	10	21	13	18	23	9	7	9
Oklahoma	.....	*a*	64	88	71	60	60	16	20	17
North Carolina	.....	*a*	2	23	12	8	9	11	1	8
West Virginia	.....	*a*	34	61	46	36	36	9	10	21
Georgia	.....	*a*	19	15	17	10	20	5	4	8
Alabama	.....	*a*	17	45	40	25	27	6	16	15
New Jersey	.....	*a*	13	17	19	16	16	4	2	15
South Carolina	.....	*a*	3	5	4	7	5	4	5	3
Virginia	.....	*a*	7	31	20	11	16	5	1	11
Connecticut	.....	*a*	30	38	34	41	33	7	11	17
Massachusetts	.....	*a*	46	56	41	34	40	8	8	11
New Hampshire	.....	*a*	47	42	38	42	39	4	5	13
Maryland	.....	*a*	17	38	16	10	15	2	2	6
Rhode Island	.....	*a*	2	2	1	1	1	.....	.....	.....
Florida	.....	.....	.....	1	.....	.....	.....	.....	.....	.....
Delaware	.....	.....	.....	1	1	.....	.....	.....	1	.....
Utah	.....	.....	.....	.....	.....	1	.....	.....	.....	.....
South Dakota	.....	.....	.....	.....	.....	1	.....	.....	.....	.....
Kansas and Nebraska	.....	*a*	3	3	6	4	9	5	4	.....
All others	[3] 688	[4] 526	.....	.....	.....	.....	.....	.....	.....	.....

[1] New York not included.
[2] No report.
[3] Including 26 other States.
[4] Including those marked "*a*".

AMOUNT CONSUMED.

Since little elm is used in the rough for building construction, ties, poles, etc., practically all of the elm timber cut (except that used for fuel) eventually reaches the factory, in the form either cf logs or lumber, to be manufactured into various products. The annual demand for elm by factories in the United States, according to the most recent statistics, amounts to about 365,000,000 feet board measure, including all forms of raw material. This figure applies more particularly to the year 1911. There has probably been some diminution in the amount used since that time on account of the waning supply. Considerable elm wood is used for fuel each year, but no estimates are available.

Table 6 shows the amount of elm used in the factories of each State. The States bordering the Great Lakes, also Missouri and Arkansas, use the largest amounts. Kentucky, Tennessee, Mississippi, and Louisiana use considerable elm. A comparison of Tables 4 and 6 shows that in general those States leading in lumber production also lead in amounts used by factories, indicating that industries using elm do not generally get their raw material at any

great distance. In the case of Pennsylvania, however, where the lumber cut of elm is small, manufacturers reported that 90 per cent was secured from outside the State. In Illinois at least 70 per cent came from outside, mostly from Michigan and Wisconsin. In New York 50 per cent of the raw material was not native to the State. In such States as Ohio, Indiana, and Missouri, where the lumber cut has decreased considerably in the past few years, the use of elm by factories is no doubt much less at the present time than is indicated in the table. In Arkansas, Mississippi, and Louisiana, on the other hand, the amounts consumed have doubtless increased recently. Many factories of Michigan and Wisconsin, especially hoop and basket factories which use material in the log, have moved to the lower Mississippi Valley during the past few years to get a sufficient elm supply.

TABLE 6.—*Annual consumption of elm in factories, by States.*

State.	Feet B. M.	State.	Feet B. M.
Michigan	79,105,951	Maryland	592,000
Ohio	59,229,054	Alabama	570,000
Wisconsin	42,193,400	Vermont	569,625
Illinois	38,308,000	Virginia	445,581
Indiana	34,578,723	West Virginia	204,000
Arkansas	22,567,000	North Carolina	197,000
New York	19,237,500	Nebraska	130,581
Missouri	19,176,103	Maine	115,500
Pennsylvania	10,415,843	Oklahoma	110,000
Tennessee	8,347,000	Kansas	107,000
Louisiana	6,858,000	South Carolina	100,000
Iowa	4,832,527	Washington	100,000
Minnesota	3,549,001	Delaware	56,246
Mississippi	3,080,000	California	40,000
Kentucky	3,059,000	Georgia	38,000
Massachusetts	2,706,000	Oregon	10,200
Texas	1,866,000	Rhode Island	4,000
Connecticut	1,295,900	Montana	1,500
New Hampshire	704,273		
New Jersey	654,440	Total	365,154,988

UTILIZATION BY INDUSTRIES.

Table 7 gives the annual factory consumption of elm grouped according to industries. These figures show that the slack cooperage industry is by far the most important, the amount credited to this use being more than twice that of the next in importance, baskets and crates. The figure for slack cooperage was obtained by converting to board feet census figures on the total amount of slack cooperage stock manufactured, while figures for other industries are in terms of amounts of lumber consumed. There is a large amount of waste in the slack cooperage industry, so that without doubt more than 147,000,000 board feet of lumber could have been produced from the same raw material which was used in the manufacture of this amount of slack-cooperage stock. The importance of this industry, therefore, is probably somewhat greater than is shown in the table. Figures for slack cooperage are those compiled by the

Bureau of the Census for the year 1911. Statistics for other industries were collected by the Office of Industrial Investigations of the Forest Service during the years 1909 to 1913. The figures given, therefore, must be taken only in a general way as representing the situation in elm utilization, since conditions change somewhat from year to year.

TABLE 7.—*Annual consumption of elm in factories in the United States, by industries.*

Industry.	Feet B. M.	Per cent.
Slack cooperage	[1] 146,954,000	39.63
Boxes, baskets, and crates	65,535,458	18.13
Vehicles and vehicle parts	31,296,922	8.66
Chairs and chair stock	23,157,586	.....
Woodenware and dairymen's and poulterers' supplies	16,383,426	4.53
Musical instruments	15,602,440	4.32
Refrigerators and kitchen cabinets	13,046,100	.....
Furniture	12,154,102	.....
Agricultural implements	7,249,000	2.01
Trunks and valises	6,409,286	1.77
Fixtures	6,368,275	.....
Planing mill products, sash and doors	6,218,860	1.72
Sporting and athletic goods	3,226,750	.89
Handles	3,060,307	.85
Toys	2,042,055	.56
Laundry appliances	1,365,000	.38
Car construction	1,221,121	.34
Machine construction	831,000	.23
Ship and boat building	706,600	.20
Machinery and apparatus, electrical	463,000	.13
Equipment, playground	334,000	.09
Saddles and harness	276,000	.08
Pulleys and conveyors	200,000	.06
Signs and supplies	200,000	.06
Brushes	187,000	.05
Dowels	175,000	.05
Gates and fencing	155,000	.04
Printing material	84,200	.02
Elevators	68,500	.02
Plumbers' woodwork	55,000	.01
Frames and moulding, picture	43,000	.01
Patterns and flasks	40,000	.01
Pumps and wood pipe	20,000	.01
Tanks and silos	15,000	(2)
Mine equipment	8,800	(2)
Boot and shoe findings	2,000	(2)
Instruments, professional and scientific	200	(2)
Total	365,154,988	100.00

[1] Amount of product reduced to board feet. From Bureau of the Census statistics on slack cooperage, which also includes small buckets, pails, and tubs. Since these articles are also included in woodenware in the table, there is probably some duplication in figures for these two industries.
[2] Less than one-half of 1/100 per cent.

Elm enters into the manufacture of a large number of products made from wood; in fact, there are probably few industries which do not furnish a demand for more or less of it.

For most uses to which elm is put the different elm species are used indiscriminately. For certain uses, however, some one species is preferred, as cork elm on account of its extreme hardness. On pages 39 to 43 is given a list of uses reported for the different species and for elm without reference to species.

Reports received from manufacturers give an average cost of $23.55 per 1,000 board feet for elm, not including the slack-cooperage industry.[1]

[1] The prices given for elm products are those in effect before the entrance of the United States into the war.

SLACK COOPERAGE.

Elm is one of the most important slack-cooperage woods of this country, being well adapted for slack barrels on account of its strength and ability to stand rough usage.

The amount of elm slack-cooperage stock manufactured in 1911, reduced to board feet, was as follows: 111,099,000 board feet of hoops, 30,871,000 board feet of staves, and 4,984,000 board feet of heading. Statistics showing the amount of elm consumed in the manufacture of this stock are not available.

Slack-cooperage statistics for the years 1907 to 1911 show that elm is by far the most used wood for hoops. In 1911 about 94 per cent of the wooden hoops produced (over 333,000,000) were of elm. The figures for 1907 to 1911 show in general a decline in the use of elm for this purpose, which is explained in part at least by the use of metal hoops.

The usual method of manufacturing elm hoops for slack cooperage stock is as follows: The logs are first cut into flitches $1\frac{9}{16}$ inches thick, and as long as the hoops to be cut from them. These flitches are then steamed; and the hoops, five-sixteenths inch thick on one edge and three-sixteenths inch thick on the other edge, are sliced lengthwise from them. The edges are next rounded, the width of the hoop being reduced in the process to $1\frac{1}{2}$ inches. The hoops are steamed, and then coiled—usually 10 or 12 are coiled together in a bundle.

The cost of manufacturing hoops in the lower Mississippi Valley region averages about $6.50 or $7 per thousand hoops. It may run as high as $7.50 per thousand or higher, depending largely on the cost of the logs. Water transportation is as a rule cheaper than rail, and slack-cooperage manufacturers located on the Mississippi River can usually secure rafted timber at a comparatively low figure. Manufacturers who buy stumpage and do their own logging also have the advantage of low cost of raw material.

Hoop makers use more of the white elm than of the other kinds. Some red elm and a little cork elm are used, but the latter is not well liked because it is difficult to work with tools. Elm grown in moist situations is more porous and bends better than that grown on higher and drier locations and for this reason is better liked by the hoop maker. On the other hand, much of the swamp-grown elm of the South is more brash than the northern elm. It is also very defective, so that there is more waste in manufacturing hoops from it than from elm grown in the North.

In 1906 elm was more largely used for staves than any other wood; in 1907 and 1908 it took third place; and in 1909, 1910, and 1911 it ranked fourth and was preceded by red gum, pine, and beech. The per cent of decrease for 1911 as compared with 1910 was greater than for any other important wood in stave manufacture. About 7 per

cent (92,614,000) of the total number of staves reported for 1911 were of elm. The output of elm staves is therefore being replaced by other woods, which is due to a depletion of the supply in the regions of stave manufacture.

Woods which steam well and retain their form when bent, and which do not taint or sour substances in contact with them, make the choicest stave material. Elm fills these requirements to a high degree, and on account of its additional advantage of great strength is generally considered the most desirable wood for slack-barrel staves.

Good quality elm staves are much in demand for the highest grade slack barrel, principally for sugar and flour. Elm is well liked for sugar barrels on account of its strength. Lower grade elm staves serve well in barrels used for shipping bottles, glassware, crockery, etc. A good grade of elm staves often brings a high price. A high grade of No. 1 for sugar and flour barrels may sell for from $9.50 to $10 a thousand. The usual price, however, is about $9. Red gum has largely replaced elm as a stave wood on account of the growing scarcity of the latter wood and the plentifulness of gum in the regions where slack stave factories are now operating. Although not as strong as elm it makes a satisfactory stave. No. 1 gum staves usually bring about $8 a thousand. Some manufacturers are unable to get more than 50 cents a thousand for elm staves above the price for gum and find it more profitable to manufacture the best of their elm into lumber, converting the more defective material into low-grade staves. Hackberry is sometimes used in place of elm. Hackberry, however, is not so strong. It is also not durable, and logs often decay badly before going into the factory.

Elm is not so much in demand for heading, because it is likely to warp when exposed to alternate wet and dry conditions. Less than 2½ per cent of the total amount of slack heading reported in 1911 was of this wood. Elm is used for head linings, which are thin strips used to hold the heading in place.

Elm is manufactured into slack-cooperage stock principally in the States bordering the Great Lakes, and in Mississippi, Arkansas, and Tennessee. In 1911 Ohio stood first in the production of hoops, Indiana second, and Michigan third. For many years the hoop industry was confined to these three States by reason of the abundance and excellent quality of the elm growing there. In 1907 they manufactured 86.4 per cent of the output and in 1908, 82.4 per cent, but in 1911 their production fell to 64.9 per cent. The hoop industry is moving southward. In 1911 Arkansas was fourth, Mississippi fifth, and Louisiana sixth in importance in the manufacture of hoops. Mississippi has shown a great increase in hoop manufacture, holding

ninth place in 1911. Hoop factories of Ohio and Indiana have been forced to go elsewhere for a supply of elm. Hoop makers in Michigan have in many cases moved to the lower Mississippi Valley on account of the growing shortage in the Great Lakes region. Memphis has of late years become the principal center of elm-hoop manufacture, a large number of factories being located within a radius of 100 miles of that city. Recently, many factories have gone farther south for fresh supplies, since the hoop maker demands a large supply of the best timber. The hoop industry will doubtless be located for some time to come chiefly in Mississippi and Louisiana.

Over one-fourth of the total amount of elm staves reported for 1911 were from Michigan. Missouri and Arkansas came next in importance. These three States produced over 60 per cent of the total amount.

Arkansas and Michigan led in the production of heading in 1911, including all woods. Woods other than elm, however, were chiefly instrumental in giving these States first place in the manufacture of this product.

FIG. 5.—Market baskets with elm rims and handles. *a*, Elm handle; *b*, elm rims—one outside, one inside; *c*, splints; *d*, metal washer.

BOXES, BASKETS, AND CRATES.

One of the most important uses of elm is in the manufacture of baskets, including fruit and vegetable packages of various kinds. Elm is used principally for the outside and inside bands or rims, on account of its strength and good bending properties. In the ordinary market basket (fig. 5) the outside and inside bands at the top and also the bent handles are preferably of elm. Two straps of elm on the bottom outside the basket make it much stronger and protect the bottom. Elm is in great demand for the bushel and half-bushel baskets (fig. 6), for the outside and inside bands and for the bale, if they have one. Enormous quantities of these baskets, used principally for shipping fruit and vegetables, are made by special machines. A special form of this type is the grain basket (Pl. IV, fig. 1), which has a wide band of elm on the inside at the top and is a strong, tight basket. Its serviceability is further increased by a round bottom of elm often both outside and inside; or a circular rim of elm may

be placed on the bottom to protect it from injury. Occasionally the staves are of elm, which makes the most serviceable basket.[1]

Basket makers generally get their wood locally in the log, or they may secure the rims from a hoop factory. It is not profitable for them to ship the raw material in any large amounts from a distance.

One of the most common uses of elm is for all kinds of crating. It can be cut into thin material and in this form can be used in long pieces. Thin elm boards 10 feet or more in length may be bent to a circle without breaking. It is therefore adapted for crating such merchandise as furniture and machinery. Crating is usually made from low-grade lumber. Factories which manufacture vehicles and furniture may buy low-grade elm and make crating from it; or they may buy log run and use the upper grades in the manufacture of their products. Manufacturers of Michigan and Wisconsin usually buy No. 3 common and cull for crating, for which they pay an average price of about $14 per thousand.

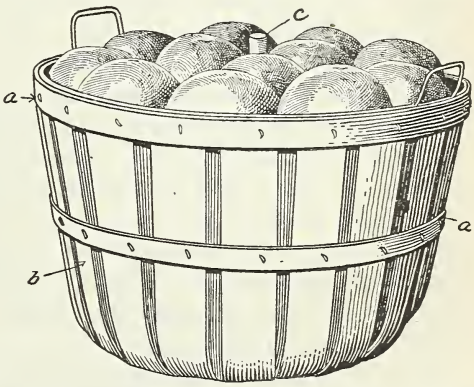


FIG. 6.—Bushel shipping basket with elm rims. *a*, Rims; *b*, splints or staves; *c*, center post which keeps fruit from being crushed. Cover not shown.

Fruit and vegetable crates of rectangular form are often made of elm. Eggs and butter are occasionally packed in elm crates. Elm wood is said not to be altogether suitable for this purpose, however, because a slight taste is imparted to these products.

Small fancy boxes are often made of white elm and nicely finished to imitate other woods. This is particularly true of tobacco boxes, for which the elm is finished in imitation of Spanish cedar. The best grade of elm is usually obtained and is less than half as expensive as the cedar. An annual consumption of nearly 2,000,000 board feet of elm was reported by manufacturers for this use alone.

Of the approximately 65,000,000 board feet of elm consumed annually for all kinds of baskets, boxes, and crating, it has been estimated that approximately 85 per cent is white elm, which is used in largest quantities in Michigan, New York, Illinois, Ohio, and Indiana.

[1] For the staves of nearly all kinds of baskets more plentiful hardwoods, such as beech and maple, are used. Beech is sometimes used to a limited extent for rims in place of elm, but does not bend so well and is not so serviceable. Birch has been tried also with fairly good results. Bushel-basket rims are sometimes made of red gum. They are much inferior to elm rims, but can be made for about one-half the cost of the elm. Hackberry is used in place of elm and is considered just as good, but only a small supply can be obtained.

The estimate for slippery elm is 12 per cent, used mostly in Illinois and Indiana. Small amounts of cork elm are used in several northern States and a small amount of wing elm in Texas. Reports from manufacturers included under this head give an average cost of $18.63 at the factory for elm. This is a low price compared to the prices paid for elm by other industries, and is due to its being obtained largely in the log and also to the utilization of low-grade material.

VEHICLES.

Elm is an important vehicle wood, an annual use of more than 31,000,000 board feet being reported. Michigan, Ohio, and Wisconsin lead in its consumption for vehicles and vehicle stock, the amount reported for these States being as follows: Michigan, 7,813,000; Ohio, 7,285,000; Wisconsin, 6,657,000. The total for the three States is nearly 70 per cent that of the entire United States. Iowa, Arkansas, Indiana, and Minnesota are next in order, consuming amounts between approximately one and two million board feet.

About two-thirds of the total was reported as white or gray elm or simply as "elm," and about one-third as cork and rock elm, and a very small per cent as slippery elm. White elm is chiefly valuable for the frames of bodies and tops of vehicles. Cork elm is used for singletrees and eveners, and for parts of the running gear, such as reaches and hounds, especially of light vehicles, and for the bows on which the top is stretched.

There has always been a good demand for rock elm for wagon and carriage hubs because of its hardness and ability to stand shock. The hub is bored out and is either completely covered by steel bands or a band sunk into it on each side to prevent checking. On account of the growing popularity of the automobile, which has all metal hubs, the demand for this material is now comparatively small. Some large wheel manufacturers have a sufficient supply of elm hub material to last for several years.

In 1911 Michigan manufacturers reported an annual consumption of 842,000 feet for automobiles. Since then there has been a considerable increase in the quantity used for automobiles, and probably a decrease in the quantity for horse-drawn vehicles.

Both the white and cork elm are used by automobile body makers. The cork or "rock" elm is used for corner blocks in the framework because of its strength and its ability to withstand shock and to hold screws. Large quantities of white and slippery elm go into the framework, chiefly in bent pieces. The more porous elm (often called swamp and water elm) is preferred, since it is said not to break so readily in bending. The wood is received at the factory in the green condition, is steamed, then bent to the desired form, held in shape, and kiln dried. Even when great care is exercised to select proper

material for bending, considerable difficulty is experienced from splintering and breaking because pieces as much as 2 inches square must be bent quite sharply at right angles. Figure 7 shows some of the common bent forms used. A good supply of satisfactory elm material is important to automobile body makers, for they consider

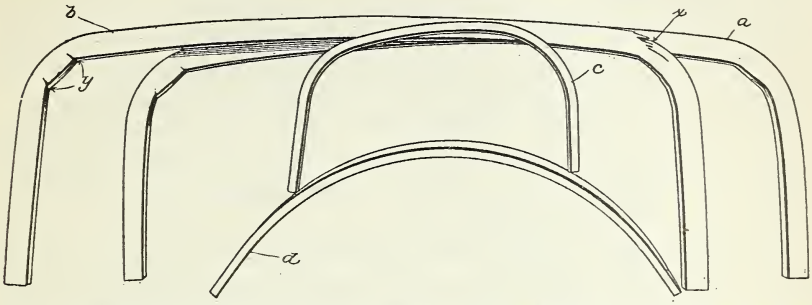


FIG. 7.—Some common forms of elm bent-wood pieces used in automobile bodies. The most exacting demands are made upon the wood by the forms *a* and *b*, used for back rails, on account of the sharpness of the bends. The two common modes of failure in bending are illustrated in *b*, which is a cull piece; in the right-hand bend at *x* splintering tension has taken place, and the left-hand bend shows compression failure at *y*, the fibers of the wood being folded over. The forms *c* and *d* are not so difficult to make, since the bends are more gradual.

that no other wood can replace it for the back rails, wheel housings (where thin material is bent in curved form), and other small bent pieces (fig. 8). Elm from southern Michigan is considered not so satisfactory for these uses as that from the northern part of the southern peninsula. That from the extreme southern States is con-

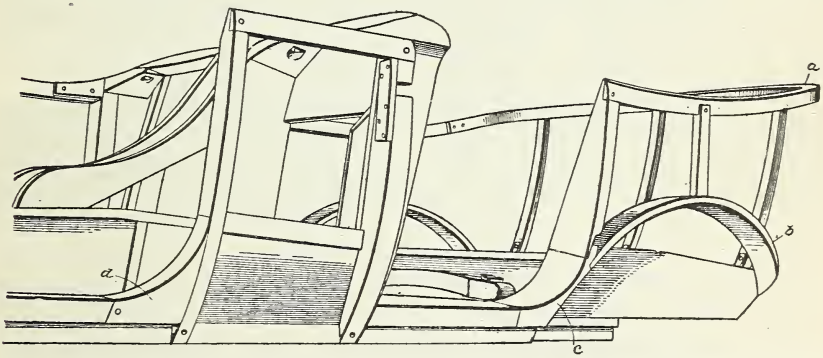


FIG. 8.—Partially assembled wooden framework of automobile body. The bent-wood piece (*a*) forming the back rail of the rear seat is soft elm, and also the circular piece (*b*), above where the wheel is to be located. The triangular blocks (*c* and *d*) to the right of each side door at the base are rock elm.

sidered inferior because of the presence of numerous defects. Material is secured mostly in the form of 1 and 2 inch lumber, and a large supply is usually kept on hand. Many automobile body makers report a purchase price of from $40 to $50 a thousand for various grades of white and rock elm. Thirty-eight dollars is the average price reported by a considerable number of such manufacturers, which

is nearly 50 per cent higher than the average cost reported for elm in the vehicle industry.

Elm is not in general use for spokes of ordinary vehicle wheels, since the wood is inclined to warp when it absorbs moisture and does not hold its shape as well as hickory. Both the cork elm and white elm are used, however, for the extremely long spokes of large wagon wheels such as are used in logging. Large log wheels as much as 9 feet in diameter are often fitted with cork-elm spokes, and it is said that no other wood has been found to be quite so satisfactory.

Cork elm is frequently used for the felloes, or bent rims, of light wagons and carriages and is said to be satisfactory as rims for bicycles in place of hickory. Cork elm serves as a substitute for hickory in many parts of light vehicles.

Cork elm is used in cutters and sleighs for the runners and running gear. White and cork elm are also used for other parts in place of ash and hickory. Elm is commonly used in the manufacture of wheelbarrows, for which it is well adapted because of its ability to stand shocks. It is used principally for the handles, for which the cork elm is most suitable. Factories generally utilize No. 2 common and better for this product.

An average cost of $26.71 per thousand board feet at the factory is reported for elm by vehicle manufacturers. This is above the average of elm for all industries, but is low for the vehicle industry. This is evidently due to the large proportion of white elm included for which a much lower price was paid than for the cork elm. For instance, in Michigan the average cost of white elm is reported as $23 a thousand and of cork elm $36. Vehicle makers demand a good grade of rock elm for such purposes as eveners, singletrees, and running gears.

No. 1 common and better 2 inches thick is generally used at a cost of from $35 to $40 a thousand feet. For cutters and sleighs, 1 and 2 inch lumber No. 2 common and better, both white and rock elm, is usually purchased at an average price of from $25 to $30.

CHAIRS AND CHAIR STOCK.

Elm is well adapted for chair making, as is shown by this industry's being fourth in importance in its use. It is used particularly for rockers, also for bent arms. It is, however, not so strong and tough as hickory, does not take so smooth a polish, and is more apt to splinter on the surface. The chair maker prefers the rock elm for most uses, but the soft elm is also used. The average price per thousand board feet paid for elm by this industry is $25.63. This is about $2 per thousand above the average for all industries.

WOODENWARE AND DAIRYMEN'S AND POULTERERS' SUPPLIES.

For such products as candy pails and tobacco buckets elm is desirable because it has very little odor and taste. It is also used for butter tubs.

Considerable elm is made into bent rims for the circular sides of such articles as cheese boxes and round measures. The raw material is generally secured in the log, slabbed, and cut into planks up to 4 inches thick, depending on the width of the rim to be cut from it. The planks are then steamed and sliced. The strips are next planed, steamed, put through rollers, and placed in a circular form which holds them in the desired shape until dry. Plate IV, fig. 2, shows rims for cheese boxes ready for shipment. In making these rims the softer grades of elm are used because of their ease in working. Cheese-box rims are also made from veneer cut directly from the log by the rotary process.[1]

Cork elm plays an important part in the manufacture of step-ladders, stepladder chairs, and stepladder stools. It is especially desirable for the top step of such ladders and for other pieces where there is considerable strain and the screws must hold very firmly and not work loose. Cork elm is a good wood for long ladders, especially for the rungs, where it is very serviceable. Tent pins and slides are made of rock elm because of its good wearing qualities.

An average price of $16.85 per thousand board feet is reported for elm used in woodenware and dairymen's and poulterers' supplies. This is about the lowest price recorded for any one industry using elm and is due to its being obtained in the log and from local sources for the manufacture of such products as bent rims. Many other articles included under this heading which take relatively small amounts pay a much higher price; rock-elm lumber for ladder rungs, for instance, usually costs the factories about $30 a thousand board feet.

MUSICAL INSTRUMENTS.

A large quantity of elm goes into pianos and organs, in which it is utilized largely for the framework. Its cheapness in comparison to other suitable woods, its strength, ability to stand shock, and good gluing qualities recommend it especially for this industry. It is not used so much now as formerly on account of its increasing scarcity. It was formerly considered as the most desirable wood for posts and backs of pianos, and considerable is still used for these parts.[2] A comparatively high price per thousand feet ($33.62) is reported for elm in this industry, since high-grade material is required.

REFRIGERATORS AND KITCHEN CABINETS.

Elm is much used for kitchen furniture, for which over 13,000,000 board feet are consumed annually. White elm is particularly adapted for kitchen cabinets and kitchen tables because it scours

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[1] Red oak is also used for rims, but is not so satisfactory. Birch is a fairly good wood for cheese-box sides. Black ash is sometimes used, but is not so suitable. Red gum has been tried, but its brittleness is a decided drawback.

[2] Hard and soft maple veneer glued together in alternate layers with a sheet of hard maple on the outside to give an attractive appearance has largely displaced elm for piano backs. Posts of hard maple are also used.

clean and white, is free from stain, taste, and odor, and has considerable stiffness and strength. It is a very desirable wood where frequent scrubbings are necessary. Elm has been employed to a considerable extent in the manufacture of refrigerators. It is not altogether satisfactory, however, because it warps in damp situations. Ash is much preferred, but often costs considerably more. An average price of $23.72 per thousand feet is paid for elm for these uses.

FURNITURE.

Elm does not hold a place of first importance as a furniture wood; but it is useful for many purposes in the industry, which uses more than 12,000,000 board feet annually, exclusive of what goes into fixtures and chairs. Its place is in cheap furniture or the interior parts of more expensive kinds. Much of the elm used for furniture goes into the framework, on account of its strength and its ability to hold screws and stand shocks. It is used especially for the framework of upholstered furniture. In recent years it has been successfully finished to imitate birch, maple, and cherry. Elm also makes a good wood for bed slats. An average price of $24.50 per thousand at the factory is reported. This is very little less than the average price reported for birch and maple for the same industry.

AGRICULTURAL IMPLEMENTS.

Over 7,000,000 feet of elm annually is reported as used for agricultural implements. It serves principally as the framework and as bent wood in many different kinds of farm implements, for which it is especially suitable, because it is comparatively light, strong, and serviceable. Cork elm and white elm are in demand for parts of cultivators, hayrakes, hay balers, thrashing machines, and reapers. White elm is commonly used for drill boxes. Cork elm is in good demand for plow handles because of its strength, ability to stand shock well, hardness, adaptability to bent work, and ability to take a smooth polish and wear smooth with use. The average cost of elm reported for these uses is $30.89 per thousand feet at the factory. Evidently a high quality of elm is demanded.

TRUNKS AND VALISES.

One of the most suitable uses for elm is for trunks. It often goes into the framework. Its chief place, however, is in the slats on the outside, where it is extremely resistent to wear and not easily broken. Few woods are considered equal to elm for this purpose. An average cost of $26.53 per thousand feet is reported by the factories.

FIXTURES.

Elm is in good demand by makers of church furniture, by whom it is made principally into curved pew seats. They like it because it bends well without steaming and glues well. The seats are built up from kiln-dry elm squares, which are glued together and held in

the curved form until the glue is dry. The partly finished seat retains its curved shape when the pressure is removed. The seat is next shaped and finished by special machinery. The ends of the pews are usually made of oak, and the elm is stained to match it. Occasionally elm is used for the entire pew.

Cabinets and store and office fixtures are occasionally made of elm.

The average price reported for elm for fixtures is $28.32 per thousand feet. This is considerably higher than the average price of this wood for furniture.

PLANING-MILL PRODUCTS, SASH, AND DOORS.

That there is a demand for elm for house and office finish is shown by the use of more than 6,000,000 feet annually for such purposes. It serves as an excellent inside finish wood because of its moderate amount of figure and pleasing light and dark shades when finished in the natural color, and makes a good appearance in panels. It is also used to imitate other woods which are more expensive, such as plain oak. A low average price ($19.05 per thousand feet) is reported for this class of products.

SPORTING AND ATHLETIC GOODS.

Cork elm is used for such products as horizontal bars and similar parts of gymnasium apparatus because of its ability to stand hard usage. White elm, finished in imitation of oak and birch, is used for low-priced billiard tables.

An average price of $30.24 per thousand board feet is reported for these uses.

HANDLES.

Elm is a suitable wood for handles because it is strong and serviceable. It is particularly in demand for certain kinds of handles, such as pike poles and cant-hook handles. Cork elm is well adapted for scythe snaths because of its strength and adaptability to bent work and because it takes a very smooth polish. Elm is not in favor for long handles, such as are used for hoes and hand rakes. It is light and strong, but its tendency to warp and twist when it absorbs moisture is a decided disadvantage. Ash is preferred for such uses.

The average price reported for elm used for handles is $17.35.

TOYS.

More than 2,000,000 feet of elm is reported as used for toys each year. Much of it goes into children's wagons and sleds.

The average cost reported for this purpose is $26.61 per thousand feet.

LAUNDRY APPLIANCES.

The good scrubbing and wearing qualities of elm when kept in contact with water make it popular material for parts of washing machines, washboards, and wash benches.

For these uses $26.96 per thousand feet is the average cost at the factory.

CAR CONSTRUCTION.

More than a million feet of elm annually has been reported as used for the interior parts of railway cars and locomotives. This is approximately one-tenth of all wood reported for this industry. Its use for this purpose is no doubt due to its strength and its shock-resisting properties, combined with its ability to take different finishes in imitation of oak and birch. The average price paid is $28.63 per thousand f. o. b. factory.

MISCELLANEOUS USES.

Elm is used in quantities of less than a million board feet annually in a large number of industries.

It was formerly a very important wood in shipbuilding on account of its shock-resisting qualities, strength, and cleaning properties. It is still in demand by barge builders and makers of small boats, but comparatively small amounts are now used by shipbuilders. The principal uses reported are for the bottom boards of canoes and the ribs of rowboats and motor boats.

Elm serves well for wooden parts of electrical machinery and apparatus. It is used in playground equipment, such as croquet sets, hammocks, and lawn swings. It is a satisfactory wood for saddle-trees, harness, neck yokes, and stirrups.

Other kinds of products into which comparatively small amounts of elm are made are pulleys and conveyors, signs and supplies, brushes, dowels (principally for furniture), gates, and fencing.

ROUGH BUILDING CONSTRUCTION.

Elm is often used for bridge planking and for bridge and trestle timbers. Rock elm is preferred for bridge planking and is usually used 2 inches thick. Such planking sells for about $20 a thousand board feet. Thicker material, of course, costs more. Elm is sometimes made into lath, for which its strength makes it suitable. The total amount of elm used for these purposes is comparatively small.

CROSSTIES.

On account of its strength, hardness, and ability to withstand shock well, elm is a desirable wood for railway crossties. Since it does not resist decay in moist situations as well as many other woods, it should be treated with preservatives for use in ties. In 1914, 43,330 elm ties were reported treated with preservatives, which was one-tenth of 1 per cent of all ties reported treated for that year. Nearly 2,000 were treated with creosote and the rest (over 41,000) with zinc chloride. In 1915, 50,846 elm ties were reported treated, which was about one-seventh of 1 per cent of all treated ties reported for that year. All were treated with zinc chloride.

FIREWOOD.

Elm is not generally considered a desirable wood for fuel, because it is difficult to work up into cordwood and to season. Its slowness in burning is another objection to its use, especially for domestic purposes, where quick heating is desired. Slippery elm, however, is fairly satisfactory on account of its comparative ease in splitting. Elm ranks high in respect to the heating value of the dry wood, a standard cord (8 feet long, 4 feet high, and 4 feet wide) being equal in heat value to a ton of coal, which puts it in the same class with oak, hickory, and beech. When there is a supply of elm timber and a scarcity of other fuels, considerable quantities of elm are utilized for fuel. The market value of fuel wood depends on its heating qualities, the rate at which it burns, its abundance and availability, and the demand for such material. In Michigan a "stove-wood" cord of elm (8 feet long, 4 feet high, and 16 inches wide) was reported as usually selling for from $2 to $2.25.

FARM USES.

Elm serves many good purposes on the farm. It is often used for flooring in stalls because it presents a rough surface and is easy on the hoofs of animals. Compared to other woods it resists abrasion well in wet situations. Rock elm makes excellent mauls and also may serve for the handles. It is put to a large number of local uses, especially where there is a good supply and other timbers are not available.

Elm is often used for fence posts, although it is not very durable in the untreated condition. Since the sapwood takes treatment well, it is advisable to apply some preservative to the wood when it is to be used for such purposes.[1]

Cedar elm is commonly used untreated for fence posts in Texas; and, although much inferior in lasting qualities to osage orange, mesquite, and the cedars of the region, the elm posts last many years in a dry climate.

GRADES USED BY DIFFERENT INDUSTRIES.

The proportion of the various grades of elm used in each of five different industries is given in Table 8. The No. 1 common grade is demanded in largest quantity by these industries. The vehicle, chair, and furniture industries can evidently use this grade to best advantage. Furniture, vehicle, and musical instrument makers demand also considerable No. 2 common. Musical instrument and agricultural implement factories have need for a good deal of high-grade elm. The last-named industry also finds place for much very

[1] See Farmers' Bulletin 744, "The Preservative Treatment of Farm Timbers."

low-grade lumber, while the other four industries buy little or none of the No. 3 common for the manufacture of their products. This grade is used largely for crating.

TABLE 8.—*Grades of elm used by different industries.*

Industry.	Firsts and seconds.	Common.		
		No. 1.	No. 2.	No. 3.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Vehicles	24	46	28	2
Chairs	27	58	15	.....
Musical instruments	50	25	25	.....
Furniture	23	43	34	.....
Agricultural implements	30	25	16	29
Average for 5 industries	31	39	24	6

GRADING RULES FOR ELM.

There are two sets of lumber-association rules under which elm is graded: The Hardwood Manufacturers' Association rules, which are used largely by manufacturers in the eastern and southeastern parts of the hardwood region of the Eastern United States, and the National Hardwood Lumber Association rules, which are used by manufacturers throughout the central and western parts of the hardwood belt and by the Michigan Hardwood Manufacturers' Association and the Northern Hemlock and Hardwood Manufacturers' Association.

Under the Hardwood Manufacturers' Association rules the grade is determined by an inspection of both sides of the board, and there are five grades for elm: Firsts and seconds, No. 1 common, No. 2 common, No. 3 common, and No. 4 common. Bright sap is admitted in all grades. In firsts and seconds (*FAS*) the pieces must be 6 inches and over wide and 8 feet and over long. A small number of specified defects are allowed, depending on the width. In No. 1 common the pieces must be 4 inches and over wide, 6 feet and over long. In general they must work 66⅔ per cent clear face. No. 2 common pieces are 3 inches and over wide, 4 feet and over long, and must work at least 50 per cent into sound cuttings. No. 3 common pieces are 3 inches and over wide and 4 feet and over long and must contain 25 per cent sound cuttings. Black sap is not a defect in No. 2 and No. 3 common. No. 4 common is a lower grade, including all unsound lumber capable of holding nails. It is used for cheap boxing, sheathing, crating, etc. These rules apply to all species of elm.

In the National Hardwood Lumber Association rules inspection is made from the poor side of the piece, and there are separate grading rules for soft (white) elm and rock (cork) elm. There are four grades: Firsts and seconds, No. 1 common, No. 2 common, and No. 3 common.

Firsts and seconds is a combined grade made up of widths 6 inches and over and lengths 8 to 16 feet. A small number of defects are admitted, according to surface measure, as specified. Nos. 1, 2, and 3 common are 3 inches and over wide and 4 feet and over long. No. 1 must work 66⅔ per cent clear face; No. 2, 50 per cent sound; and No. 3, 25 per cent sound. Black spots and black streaks are defects.

A general similarity is seen in these two sets of rules. Of course inspection on the poor side of the piece raises the quality of the lumber in a particular grade.

The National Hardwood Lumber Association grades cork elm lumber, called "rock elm," under the same rules as hickory and pecan, since they are largely manufactured into the same products. Four grades are specified: Firsts and seconds, No. 1 common, No. 2 common, and No. 3 common. Firsts and seconds are 4 inches and over wide, and a specified number of defects is allowed according to width and length of piece. No. 1 common is 4 inches and over wide, 4 feet and over long, and must work 66⅔ per cent clear face. No. 2 common is 3 inches and over wide, 4 feet and over long, and must work 50 per cent sound. No. 3 common is also 3 inches and over wide, 4 feet and over long, and must contain at least 25 per cent of sound cuttings.

LUMBER AND STUMPAGE VALUES.

LUMBER PRICES.

Table 9 gives the average value of elm lumber f. o. b. mills for different States and years as given in manufacturers' reports on annual lumber production. Tables 10 and 11 give the average wholesale price f. o. b. mill from 1909 to 1916, inclusive, for different grades of soft and rock elm lumber in various States. The tables are based on reports to the Forest Service of actual sales by a number of the largest manufacturers in the different States. Prices are quoted for lumber 1 inch (4/4) thick of the different grades, and for mill run, which consists of all grades combined.

The 1917 wholesale prices of different grades of soft and rock elm lumber in the principal centers of its distribution are given in Table 12. Table 13, which is based on actual sales, gives average wholesale prices of different grades of soft and rock elm lumber f. o. b. mills in Wisconsin. These prices apply to lumber practically all of which is manufactured and graded according to the National Hardwood Lumber Association's grading rules.

TABLE 9.—*Average value of elm lumber per 1,000 board feet (f. o. b. mills) in different States for different years.*

State.	1899	1904	1906	1907	1908	1909	1910	1911	1912	1915
United States	$11.47	$14.45	$18.08	$18.45	$18.40	$17.52	$18.67	$17.13	[1] $16.87	$16.98
Wisconsin	11.82	14.62	17.10	19.26	18.80	17.48	19.46	17.81	16.52	12.59
Michigan	10.94	13.83	18.51	20.28	20.82	19.96	21.88	18.75	17.50	18.15
Arkansas	10.91	8.49	14.57	13.38	14.41	14.92	14.61	14.15	.....	15.32
Indiana	11.02	16.45	19.10	18.63	19.10	19.42	18.64	17.22	17.23	18.03
Ohio	12.28	16.47	18.64	19.59	18.85	20.21	19.77	18.24	.....	18.31
New York	13.19	15.80	25.00	24.00	24.00	16.19	21.81	18.76	.....	18.16
Missouri	10.32	13.41	15.32	14.02	14.34	15.18	16.50	15.92	.....	14.83
Tennessee	8.80	13.56	15.59	13.83	14.44	13.53	15.11	12.84	.....	16.38
Louisiana	10.00	.....	.....	15.39	13.76	13.91	13.94	14.58	.....	15.15
Mississippi	.....	12.95	.....	14.51	14.78	15.05	15.79	15.00	.....	14.92
Minnesota	9.04	12.26	.....	15.51	14.68	14.47	13.80	14.40	.....	13.93
Illinois	11.41	14.26	17.10	15.52	15.24	16.18	15.53	15.92	.....	13.12
Kentucky	12.77	12.86	14.28	14.19	.....	16.00	12.20	12.19	.....	14.46
Iowa	12.57	14.61	.....	16.99	16.24	19.28	17.94	17.09	.....	19.71
Pennsylvania	12.32	19.77	17.98	15.98	16.54	16.19	16.10	17.67	.....	15.95
Vermont	11.33	11.04	.....	15.51	14.97	14.80	13.43	14.27	.....	14.81
Maine	10.04	.....	.....	15.56	14.27	15.27	14.25	12.50	.....	13.93
Texas	11.97	.....	.....	10.83	12.26	17.15	17.88	.....	.....	13.77
Oklahoma	12.30	.....	.....	15.74	10.65	13.06	12.57	12.50	.....	13.61
North Carolina	.....	.....	.....	16.50	14.00	23.33	17.33	.....	.....	14.79
West Virginia	.....	14.31	.....	26.89	12.96	14.06	.....	.....	.....	.....
Georgia	.....	9.00	.....	13.46	18.16	10.10	13.29	11.80	.....	13.96
Alabama	17.19	.....	.....	15.12	16.58	17.88	12.68	10.93	.....	15.11
New Jersey	11.36	28.00	.....	26.32	20.62	24.25	21.00	.....	.....	14.86
South Carolina	.....	.....	.....	19.38	15.00	19.58	17.00	.....	.....	14.75
Virginia	10.00	.....	.....	11.87	13.66	13.02	.....	.....	.....	.....
Connecticut	25.00	.....	.....	17.08	12.43	15.16	15.27	14.33	.....	18.45
Massachusetts	.....	.....	.....	14.69	11.54	13.44	14.38	13.67	.....	13.58
New Hampshire	.....	.....	.....	14.42	14.23	13.93	14.21	13.29	.....	15.29
Maryland	.....	.....	.....	15.54	9.40	13.30	13.25	12.60	.....	13.33
Rhode Island	.....	.....	.....	12.12	18.00	14.00	.....	.....	.....	.....
Florida	.....	.....	.....	.....	.....	12.00	.....	.....	.....	.....
Delaware	.....	.....	.....	.....	.....	14.33	.....	.....	.....	.....
Kansas	12.75	12.86	.....	.....	.....	16.00	18.67	.....	.....	.....
Nebraska	10.41	.....	.....	.....	.....	.....	.....	.....	.....	.....

[1] 1912 values based on a limited number of reports.

TABLE 10.—*Average wholesale price of soft elm lumber (per 1,000 board feet) in various States, based on actual sales made f. o. b. mill, for the years 1909–1916.*

SOFT ELM.

State and grades.	1909	1910	1911	1912	1913	1914	1915	1916
Arkansas:								
No. 1 common and better 4/4	.....	$18.48	$21.08	$22.83	.....	.....	.....	.....
No. 2 common and better 4/4	.....	14.88	15.62	17.15	.....	.....	.....	.....
Mill run	$14.65	14.60	15.46	16.25	.....	.....	.....	.....
Connecticut:								
Mill run	15.00	.....	.....	.....	.....	.....	.....	.....
Illinois:								
No. 1 common and better 4/4	18.03	.....	.....	.....	.....	.....	.....	.....
Mill run	15.45	15.00	15.92	.....	.....	.....	.....	.....
Indiana:								
Firsts and seconds 4/4	22.60	.....	.....	.....	.....	.....	.....	.....
No. 3 common 4/4	15.12	.....	.....	.....	.....	.....	.....	.....
No. 1 common and better 4/4	20.78	22.40	23.48	23.03	.....	.....	.....	.....
No. 2 common and better 4/4	.....	16.76	18.88	20.66	.....	.....	.....	.....
Mill run	18.59	18.64	19.00	17.23	.....	.....	.....	.....
Iowa:								
Mill run	.....	.....	17.08	.....	.....	.....	.....	.....
Kentucky:								
No. 2 common and better 4/4	.....	15.50	.....	.....	.....	.....	.....	.....
Mill run	.....	.....	.....	14.50	.....	.....	.....	.....
Louisiana:								
Mill run	.....	16.00	15.50	.....	.....	.....	.....	.....
Massachusetts:								
Mill run	17.33	.....	.....	.....	.....	.....	.....	.....
Michigan:								
Firsts and seconds 4/4	33.50	.....	.....	.....	$40.00	$39.88	$38.69	$39.50
No. 1 common 4/4	.....	.....	.....	.....	29.33	29.88	28.69	29.50
No. 2 common 4/4	.....	.....	.....	.....	22.00	22.38	19.88	19.00
No. 3 common 4/4	11.35	.....	.....	.....	14.88	15.66	13.99	14.18
No. 1 common and better 4/4	26.40	27.30	29.16	28.27	.....	.....	.....	.....
No. 2 common and better 4/4	.....	24.17	24.01	25.63	28.81	27.50	26.02	29.59
No. 3 common 6/4	.....	.....	.....	.....	.....	.....	16.00	16.00

TABLE 10.—*Average wholesale price of soft elm lumber (per 1,000 board feet) in various States, based on actual sales made f. o. b. mill, for the years 1909–1916*—Continued.

SOFT ELM—Continued.

State and grade.	1909	1910	1911	1912	1913	1914	1915	1916
Michigan—Continued.								
Firsts and seconds 8/4							$36.25	
No. 1 common 8/4							26.25	
No. 2 common 8/4							16.25	
Mill run	$21.19	$20.59	$19.00		$23.65	$21.87	22.08	$24.98
Mississippi:								
No. 2 common and better 4/4		15.75	14.92					
Mill run	15.62	15.79	15.00	$15.84				
Missouri:								
Firsts and seconds 4/4	29.25							
No. 3 common 4/4	15.75							
No. 1 common and better 4/4		15.00						
Mill run	14.55	16.50	14.88	12.33				
New York:								
No. 3 common 4/4	14.00							
No. 1 common and better 4/4				25.00				
No. 2 common and better 4/4		26.00	18.00					
Mill run	20.63	20.44	20.50	18.84				
Ohio:								
Firsts and seconds 4/4	27.50							
No. 3 common 4/4	14.62							
No. 1 common and better 4/4	22.67	24.23	22.47	24.75				
No. 2 common and better 4/4		17.22	17.06	19.17				
Mill run	18.74	18.38	18.18	15.71				
Pennsylvania:								
Mill run			17.67	16.67				
Tennessee:								
Mill run	16.67	15.11						
Vermont:								
Mill run		17.25	17.50	15.40				
Wisconsin:								
Firsts and seconds 4/4	29.00						33.50	36.50
No. 1 common 4/4						27.00	22.75	24.50
No. 2 common 4/4							14.50	14.75
No. 3 common 4/4	9.45				15.22	14.33	11.37	12.14
No. 1 common and better 4/4	22.19	24.68	25.14	26.02				
No. 2 common and better 4/4		20.67	19.53	19.78	24.73	25.22	23.67	26.50
Mill run	17.32	16.80	16.74	15.20	21.03	14.00	17.46	18.62

TABLE 11.—*Average wholesale price of rock elm lumber (per 1,000 board feet) in various States, based on actual sales made f. o. b. mill, for the years 1909–1916.*

ROCK ELM.

State and grades.	1909	1910	1911	1912	1913	1914	1915	1916
Arkansas:								
Mill run				$16.33				
Indiana:								
Firsts and seconds 8/4	$27.50		$37.57	36.34				
No. 1 common 8/4	26.66							
No. 1 common and better 8/4			29.00	27.50				
No. 2 common and better 8/4				22.75				
Mill run	19.38		19.83					
Michigan:								
Firsts and seconds 8/4								
No. 2 common 8/4								
No. 3 common 8/4	11.72				$12.00	$12.00		
No. 1 common and better 8/4			23.33					
No. 2 common and better 8/4		$28.98	24.29	26.08	26.50	27.50	$28.00	
Mill run	25.65	23.16	24.00	21.50	19.49			
New York:								
Mill run		23.17	22.50					
Ohio:								
Firsts and seconds 8/4	18.00							
Mill run	16.50	21.05	18.38	16.33				
Vermont:								
Mill run		15.67	15.83					
Wisconsin:								
Firsts and seconds 8/4	38.12	33.60	32.68	33.18		40.00		$46.00
No. 1 common 8/4	27.38							36.00
No. 2 common 8/4					17.50	22.00		22.00
No. 3 common 8/4	10.07				13.62	16.00		11.33
No. 1 common and better 8/4		24.31	26.31	23.72				
No. 2 common and better 8/4		24.81	22.41	21.97	25.08	26.31	23.54	30.02
Mill run	22.69	21.40	18.88	17.84	22.87		17.00	19.00

TABLE 12.—*Wholesale prices*[1] *(per 1,000 board feet) of elm lumber in important centers of lumber distribution and utilization.*

SOFT ELM.

	First and seconds, 6 inches and up wide.			No. 1 common, 4 inches and up wide.			No. 2 common, 3 inches and up wide.			No. 3 common, 3 inches and up wide.			Log run, M. C. O.		
	1 inch.	1½ inches.	2 inches.	1 inch.	1½ inches.	2 inches.	1 inch.	1½ inches.	2 inches.	1 inch.	1½ inches.	2 inches.	1 inch.	1½ inches.	2 inches.
Boston	$49.00	$51.00	$53.00	$39.00	$41.00	$43.00	$29.00	$31.00	$33.00	$24.00	$25.00	$26.00	$39.00	$41.00	$43.00
New York	48.00	50.00	52.00	38.00	40.00	42.00	28.00	30.00	32.00	23.00	24.00	25.00	38.00	40.00	42.00
Rochester	47.50	49.50	51.50	37.50	39.50	41.50	27.50	29.50	31.50	24.00	25.00	26.50	36.00	39.00	41.50
Buffalo	46.00	48.00	50.00	36.00	38.00	40.00	26.00	28.00	30.00	21.00	22.00	23.00	36.00	38.00	40.00
Philadelphia, Baltimore, and Washington	47.00	49.00	51.00	37.00	39.00	41.00	27.00	29.00	31.00	22.00	23.00	24.00	37.00	39.00	41.00
Pittsburgh	46.00	48.00	50.00	36.00	38.00	40.00	26.00	28.00	30.00	21.00	22.00	23.00	36.00	38.00	40.00
Richmond and Norfolk	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28.00	31.00	32.00
Cincinnati and Kenova	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26.50	29.50	31.50
Evansville	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26.50	29.50	31.50
Indianapolis	45.00	47.00	49.00	35.00	37.00	39.00	25.00	27.00	29.00	20.00	21.00	22.00	35.00	37.00	39.00
Chicago	42.00	44.00	46.00	32.00	34.00	36.00	22.00	24.00	24.00	17.00	18.00	18.00	32.00	34.00	36.00
Cleveland	45.50	47.50	49.50	35.50	37.50	39.50	25.50	27.50	29.50	20.50	21.50	22.50	35.50	37.50	39.50
Detroit and Grand Rapids	42.00	44.00	46.00	32.00	34.00	36.00	22.00	24.00	26.00	17.00	18.00	19.00	32.00	34.00	36.00
Wausau, Wis	39.00	41.00	43.00	29.00	31.00	33.00	19.00	21.00	23.00	14.00	15.00	16.00	29.00	31.00	33.00
St. Paul and Minneapolis	40.50	42.50	44.50	30.50	32.50	34.50	20.50	22.50	24.50	15.50	16.50	17.50	30.50	32.50	34.50
St. Louis	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25.50	28.50	30.50
Kansas City	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28.00	31.00	33.00
Denver	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36.50	38.50	40.50
Los Angeles, San Francisco, and Seattle	61.00	63.00	65.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cairo and Thebes	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	24.50	27.50	29.50
Memphis	28.00	31.00	34.00	18.00	21.00	24.00	13.00	15.00	17.00	9.00	11.00	13.00	19.00	24.00	24.00
New Orleans	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	22.00	26.00	28.00

ROCK ELM.

	4 inches and up wide.			3 inches and up wide.											
Boston	$53.00	$55.00	$57.00	$43.00	$45.00	$47.00	$29.00	$31.00	$33.00	$26.00	$27.00	$28.00	$38.00	$41.00	$43.00
New York	52.00	54.00	56.00	42.00	44.00	46.00	28.00	30.00	32.00	25.00	26.00	27.00	37.00	40.00	42.00
Rochester	51.00	53.00	55.00	41.00	43.00	45.00	27.00	29.00	31.00	24.00	25.00	26.00	36.00	39.00	41.00
Buffalo	49.00	51.00	53.00	39.00	41.00	43.00	25.00	27.00	29.00	22.00	23.00	24.00	34.00	37.00	39.00
Philadelphia, Baltimore, and Washington	51.00	53.00	55.00	41.00	43.00	45.00	27.00	29.00	31.00	24.00	25.00	26.00	36.00	39.00	41.00
Pittsburgh	49.00	51.00	53.00	39.00	41.00	43.00	25.00	27.00	29.00	22.00	23.00	24.00	34.00	37.00	39.00
Indianapolis	48.00	50.00	52.00	38.00	40.00	42.00	24.00	26.00	28.00	21.00	22.00	23.00	33.00	36.00	38.00
Chicago	44.50	46.50	48.50	34.50	36.50	38.50	20.50	22.50	24.50	17.50	18.50	19.50	29.50	32.50	34.50
Cleveland	47.50	50.50	52.50	38.50	40.50	42.50	24.50	26.50	28.50	21.50	22.50	23.50	38.50	36.50	38.50
Detroit and Grand Rapids	44.50	46.50	48.50	34.50	36.50	38.50	20.50	22.50	24.50	17.50	18.50	19.50	29.50	32.50	34.50
Wausau, Wis	41.00	43.00	45.00	31.00	33.00	35.00	17.00	19.00	21.00	14.00	15.00	16.00	26.00	29.00	31.00
St. Paul and Minneapolis	43.00	45.00	47.00	33.00	35.00	37.00	19.00	21.00	23.00	16.00	17.00	18.00	28.00	31.00	33.00
Kansas City	46.00	48.00	50.00	36.00	38.00	40.00	26.00	28.00	30.00	21.00	22.00	23.00	36.00	38.00	40.00
Denver	50.00	52.00	54.00	40.00	42.00	44.00	30.00	32.00	34.00	25.00	26.00	27.00	40.00	42.00	44.00
Los Angeles, San Francisco, and Seattle	68.00	70.00	72.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

[1] From the market report of Feb. 15, 1917, of the Lumbermen's Bureau, Washington, D. C. These prices are reported to represent actual selling prices in the principal markets of lumber in car lots to the retail and factory trade.

TABLE 13.—*Average wholesale prices*[1] *of elm lumber (per 1,000 board feet) f. o. b. mill, based on actual sales by mills in Wisconsin, January and February, 1917.*

Grade.	Soft elm.		Rock elm, 8/4.
	4/4	6/4	
Firsts and seconds	$36.63	$43.08	$48.36
No. 1 common	26.87	32.94	37.36
No. 2 common	18.14	21.75	19.00
No. 3 common	14.42	15.33	16.37
No. 2 common and better	24.91	30.57	.....

[1] Figures compiled from prices of actual sales published in the weekly bulletin of the Northern Hemlock and Hardwood Manufacturers' Association.

TABLE 14.—*Average stumpage values of elm for 1907 and 1912.*

State and group.	1907	1912
Northeastern States:		
Maine	$3.00 (7)	$3.71 (26)
New Hampshire	4.65 (10)	5.25 (8)
Vermont	4.07 (15)	4.25 (12)
New York	5.07 (14)	6.17 (56)
Pennsylvania	5.35 (30)	5.93 (31)
Average of 5 States	4.74 (76)	5.40 (133)
North Central States:		
Ohio	7.11 (37)	9.43 (76)
Indiana	7.64 (52)	7.78 (78)
Average of 2 States	7.42 (89)	8.59 (154)
Southern Appalachian States:		
Maryland	4.50 (2)	4.56 (8)
Virginia	2.17 (6)	2.67 (3)
West Virginia	2.19 (8)	3.00 (1)
Kentucky	3.82 (24)	4.09 (29)
Tennessee	2.29 (13)	2.80 (33)
North Carolina	.....	3.70 (5)
Average of 6 States	3.04 (53)	3.51 (79)
Lake States:		
Michigan—		
Upper Peninsula	4.03 (19)	.....
Lower Peninsula	8.34 (62)	.....
Southern tier of counties	9.67 (6)	.....
State average	7.49 (87)	8.77 (82)
Wisconsin	4.72 (76)	5.01 (112)
Minnesota	4.22 (9)	6.70 (33)
Average of 3 States	6.10 (172)	6.61 (227)

NOTE.—The numerals in parentheses indicate the number of reports on which the averages are based. Taken from Department of Agriculture Bulletin 285, The Northern Hardwood Forest, Table 12.

VALUE OF STANDING TIMBER.

Census reports on manufactures for 1899 give a stumpage price for elm of $3.43 per thousand board feet for Michigan and $2.39 for Missouri, and an average for the United States of $3.30. In the report for the year 1904 the price had risen to $5.58 per thousand for the United States. Census figures for later years are not available. Table 14 gives average stumpage values of elm by States and groups of States for 1907 and 1912. These figures are averages of estimates by timberland owners. Reports of actual sales of stumpage in 1912 collected by the Forest Service give an average price of $8.40 per thousand board feet in the Northeastern States (Maine, New Hampshire, Vermont, Massachusetts, New York, and Penn-

sylvania), $5.87 in the Lake States (Michigan, Wisconsin, and Minnesota), and $3.41 in the Southern States (Maryland, Virginia, West Virginia, Kentucky, Tennessee, and North Carolina). Although based on many reports of actual sales, these figures show only general tendencies of stumpage prices in these three regions.

Elm stumpage is now largely bought up by slack cooperage and basket manufacturers, etc. Factories which can not use other woods in place of elm can usually afford to pay better prices for it than can the lumber manufacturers. An average price paid for soft elm on the stump by factories in southern Michigan would be about $12 per thousand board feet. The logs usually bring from $15 to $20 at the factory. In the lower Mississippi Valley the prices are somewhat lower. Firms cutting their own timber in that section figure that elm logs are worth about $8 per thousand board feet at the mill. This is about what it costs to cut and transport to the mill, allowing for stumpage only $1.50 per thousand feet, for which mixed hardwood timber has been purchased in that region. A good quality of elm stumpage, of course, brings a much higher figure, depending on quality, amount, accessibility, etc. Rock-elm stumpage ordinarily sells for from $15 to $20, and at the factory the logs sell for about $25 on the average. A high grade of rock elm sells for higher prices for special purposes. It is reported that as much as $65 per thousand has been paid in southern Michigan for rock-elm stumpage, only choice trees here and there being selected.[1]

COST OF LUMBER PRODUCTION.

Since elm is commonly manufactured into lumber along with other woods with which it grows in mixture, the cost of converting it into lumber is difficult to ascertain. A theoretical cost can of course be obtained by subtracting the stumpage value from the mill-run value of the timber at the mill. For instance, subtracting the 1912 value of elm stumpage in Michigan (Table 14), which is about $9, from the average mill-run value of soft elm lumber, which is approximately $25, leaves $16, which represents the cost of production per thousand board feet, including the lumber manufacturers' profit.

Portable sawmills in Michigan generally charge from $4 to $4.50 per thousand board feet for sawing. The lumber produced by these mills, however, is often not well manufactured, and not so valuable for many purposes as that turned out by large stationary mills. There is also usually more waste in the portable mill.

MARKETS.

Elm timber may be disposed of on the stump, in the log, or in the form of manufactured lumber. Considerable quantities are supplied from woodlots by farmers who sell the logs to wood-using factories or to local sawmills.

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[1] These prices were compiled, in part, from quotations furnished by the Michigan Agricultural College, Lansing, Mich.

Slack-cooperage factories afford a good market for elm in the log. They demand sound, straight-grained timber with clear boles and few knots. Hoop makers in the lower Mississippi Valley generally pay from $12 to $18 per thousand board feet for delivered logs, depending on the quality. A good grade of elm logs delivered at the railroad in Arkansas should bring $15 a thousand board feet log scale. Manufacturers are often able, however, to secure their elm at a lower figure. Factories along the Mississippi River can usually secure mixed hardwood logs in rafts, including elm, gum, cottonwood, sycamore, and ash, for from $8 to $10 a thousand board feet. A good grade of elm logs when sold alone will usually bring from $13 to $14 per thousand feet. Slack-cooperage firms are often able to buy mixed timber, including elm, on the stump at a low figure and transport the logs to the factory at a total cost of $8 a thousand, including the stumpage price. In Michigan and Wisconsin about $20 per thousand is the usual price for good-quality logs delivered. Hoop factories can use the logs as small as 12 inches in diameter at the small end, and the usual lengths are 12, 14, and 18 feet.

Factories making baskets and fruit and vegetable packages consume large quantities of elm in the log and generally pay on the average about $18 a thousand in southern Michigan and Wisconsin. Cheese-box factories get practically all their wood in the log, and the elm is purchased at an average price between $15 and $16 per thousand. Such factories can utilize low-grade material. These prices are for soft elm logs f. o. b. factory. Where there is a demand for rock elm in the log, a better price should be secured than for the soft elm. A good quality of practically clear rock elm in the log may bring a high price where it is necessary for the manufacture of certain products, as for parts of vehicles.

There was formerly a good demand for high-grade cork elm in the log or bolt by wheel makers for hubs, but this demand is now comparatively small. Pieces in the round as small as 4 inches are utilized, and material must be practically clear.

Elm logs are often sold according to grade. The Hardwood Manufacturers' Association of the United States specifies three grades of elm logs: No. 1, select, and No. 2. No. 1 logs are 24 inches and over in diameter, select are 18 inches and over, and No. 2 are 16 inches and over. The grade is otherwise determined, in each diameter, by the number of defects. Bright sap is not considered a defect. Purchasers often have log specifications of their own, which are altogether different from those just given, and are suited to their own requirements.

Where there is a considerable amount of elm and other good saw timber, it may be more profitable to convert it into lumber than to dispose of it in the log. It should be remembered, however, that

well-manufactured lumber is much more valuable than lumber that is poorly manufactured. Some of the product turned out by portable sawmills can not command good prices for this reason. It usually pays well to exercise care in securing exact and uniform sizes of lumber. Graded lumber can usually be sold at a higher price than the ungraded or "mill run" because its quality is better known. The manufacturer can also generally use the graded stock to better advantage, because it is better suited to his special requirements.

Manufacturers of vehicle stock buy considerable cork and white elm, and a good price can usually be obtained for high-grade material. There is a good demand by automobile body makers for thick material of cork elm and for white elm suitable for bending. Chair factories also use considerable elm in bent work and can generally utilize large amounts of No. 1 common and better grades. Manufacturers of other elm products, such as furniture, chairs, church pews, and agricultural implements, also usually buy graded lumber to meet their requirements. Factories often buy a certain combination of grades. Furniture factores, for instance, often buy a "No. 1 common and better" grade. Some factories find it an advantage to buy as low as "No. 3 common and better" and use the lowest grade for crating.

Timber owners often can secure valuable information on markets from State foresters, forest and agricultural schools, and the United States Department of Agriculture.[1] Lists of uses for elm are given on pages 39 to 43 of this bulletin.

ELM IN THE WOODLOT.[2]

With the great modern reduction in the timber supplies of the country, the farm woodlot has constantly gained in importance as a source of timber for both local and general consumption. Elm, while rarely very abundant in woodlots, is still of frequent occurrence in them.[3] The different kinds are rather alike in their growth needs.

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[1] Woodlot owners should secure Farmers Bulletin 715, "Measuring and Marketing Woodlot Products."

[2] Prepared by E. H. Frothingham, Office of Forest Investigations.

[3] An idea of the degree of prevalence of elm in woodlots is given in the following statement, compiled from reports of woodlot owners in different States and counties. The figures have no relation to the abundance of elm, but simply give the percentage of the woodlots examined which contained elm, whether in large or in small quantity:

Percentage of woodlots examined which contained elm.

Region.	Per cent.
Northeastern Connecticut (Windham County)	1.3
Northwestern Vermont (Franklin County)	8.2
Northern Indiana (Kosciusko County)	53.3
Central Indiana (Madison County)	68.4
Southern Indiana (Jackson County)	16.2
Central Wisconsin (Marathon County)	46.8
Southern Minnesota (McLeod County)	84.0
Eastern Iowa (Jones County)	53.3
Southeastern Nebraska (Gage County)	54.3
Central Tennessee (Rutherford County)	40.0

All need much light, and so do best when their crowns are well above those of their neighbors. This is the usual position of white elm, at least, in the old-growth forests. All make their best growth in good deep, fresh, or moist soil with good drainage, but will succeed even on upland sandy or stony soil, if not too dry and shallow. Where creeks run through woodlots, elms are more apt to be found along their borders among such trees as maple, beech, birch, white and red oaks, and basswood. Among the oaks, hickories, pine, etc., which commonly occupy the drier sites, elms are usually rare or absent. In woodlots in river bottoms white elm is often one of the most abundant trees, growing among cottonwoods, silver maples, sycamores, and other moisture-loving species.

Most of the woodlot elm is white elm, especially in the region north of central Ohio, Indiana, and Illinois. This is rather unfortunate, since for woodlot purposes white elm is probably the least useful of the three common species (white, cork or "rock," and slippery or "red" elm). Its growth rate, while only moderate, is more rapid than that of the other species, but the usefulness of the wood for farm purposes is less. It is less desirable than slippery elm for fuel, and probably somewhat less resistant to decay and therefore less useful for fence posts, sills, etc. For lumber or bolts intended for wagon manufacture and similar purposes, cork elm is, of course, superior to the other species.

Where mature elm of either of these three species, or young, thrifty trees of cork or slippery elm are present in a woodlot they should be counted a resource; but it is often of doubtful advisability to plant elm or attempt to secure natural reproduction, for the purpose of producing wood. Efficiency in woodlot management or planting demands careful discrimination as to species, and various species of oak, pine, etc., may often be better material, depending on soil, drainage, and economic conditions, than elms. Before making the choice as to trees to be planted or favored in woodlots, owners should secure whatever information is available with reference to the different useful species and the conditions under which each is worthy of selection. Advice on such questions can usually be obtained easily from State foresters in the States which employ them, from forest schools, or from the Forest Service, United States Department of Agriculture.[1]

SUMMARY AND CONCLUSIONS.

The value of elm wood for special purposes is due to its strength, excellent bending qualities, and high degree of ability to stand shock. These properties make it valuable for hoops of various kinds, basket

[1] The following bulletins of the United States Department of Agriculture contain information which may be of use to woodlot owners in this connection:

Bulletin 153, "Forest Planting in the Eastern United States."

Bulletin 481, "Status and Value of Farm Woodlots in the Eastern United States."

Farmers' Bulletin 711, "Care and Improvement of the Woodlot."

rims and handles, bent work in vehicles and chairs, and framework of such products as furniture and agricultural implements.

Elm is becoming scarce, and consequently higher priced. In the region of the Great Lakes, where the largest supply has been, factories often find it difficult to get a sufficient quantity, and many of them have been forced to remove to the lower Mississippi Valley region for a new supply.

A fairly constant, though probably diminishing, supply of elm is assured for a long time to come because the different elm species, taken altogether, have a wide range and form an appreciable percentage of the mixed hardwood stand throughout the eastern half of the United States. In many strictly agricultural areas elm is often found near streams and on lands not suitable for tilling. Farmers' woodlots, which have furnished a large part of the past supply of elm, can not be depended upon, however, for a constant future supply, because farmers will prefer more rapid growth and more widely useful species.

The future use of elm will be restricted for the most part to those purposes for which other species are not satisfactory. On account of the higher price and increasing scarcity of the supply, manufacturers are substituting many other woods for elm where this is possible.

Elm in the log can be best utilized for hoops, parts of baskets, and such articles as cheese-box rims. A good grade of elm is required for bent work by manufacturers of different kinds of vehicles and furniture. The cork elm and dense second-growth material of other elm species is particularly in demand by vehicle makers, especially automobile-body manufacturers, and for certain kinds of woodenware articles. Large amounts of low-grade elm are used by factories for crating.

Timber owners are often enabled to find a suitable market by writing to the Forest Service, United States Department of Agriculture, and to State forestry officials.

CLASSIFIED USES OF ELM IN DIFFERENT WOOD-USING INDUSTRIES.

WHITE ELM.

Agricultural implements.—Cultivator frames, cultivators, drill boxes, fishbacks, harrows, hay balers, hay racks, hayrakes, plow handles, machine platforms, potato diggers, press racks, root cutters, seeder rims, shoveling-board cleats, spraying machines, stump pullers.

Baskets and crates.—Bails, basket; bands, basket; bottoms, basket; baskets, banana; baskets, bushel; baskets, fruit; baskets, grain; baskets, grape; baskets, shipping; baskets, splint; baskets, split; baskets, vegetable; baskets, waste; box shooks; boxes, apple; boxes, candy; boxes, cigar; boxes, comb; boxes, knife; boxes, seed; boxes, trunk; boxes, veneer; boxes, wheelbarrow; boxes, woven; cases, egg; cleats, bottom; crates, bushel; crates, egg; crates, onion; crates, potato; crating; crating, automobile; crating, buggy; crating, carriage; crating, wagon; frames, banana carriers; hampers,

banana; hampers, clothes; handles, basket; hoops, basket; packages, fruit; packages, vegetable; packing, fruit.

Brushes.—Brush backs; brush blocks.

Car construction.—Car repairing; cars, electric; locomotive cabs, interior; railway coaches; tie plugs.

Dairymen's and poulterers' supplies.—Brooders; cheese-box frames; cheese-box rims; cheese boxes; coops, chicken; dashers; incubators; poultry roosts.

Dowels.—Dowels.

Elevators.—Elevators.

Equipment, playground.—Bent hammock spreaders; hammocks, porch; merry-go-round parts.

Frames and molding.—Moldings, picture.

Furniture and fixtures.—Bed rails; Bible stands; bookcases, inside cork; cabinets; cabinets, medicine; cabinets, seed; cabinets, toilet; carvings; chair backs; chair bottoms; chair frames, upholstered; chair rods; chair-seat frames; chair seats; chair stock; chairs, bent; chairs, kitchen; chiffoniers; china closets, inside work; church furniture; commodes; commodes, inside work; costumers; cots; couch frames; couches; cribs; cupboards; davenport frames; davenports; drain boards; drawer ends; drawer sides; drawer tops; dressers; fixtures; fixtures, bank; fixtures, bar; fixtures, barber shop; fixtures, office; fixtures, store; furniture frames; furniture frames, upholstered; furniture, office; ice boxes; ice chests; kitchen-cabinet backs; kitchen-cabinet partitions; kitchen-cabinet posts; kitchen-cabinet shelves; kitchen cupboards; kitchen safes; lounge frames; mission furniture; music cabinets; opera chair backs; opera-chair seats; parlor cabinets, inside work; pew backs; pew ends; pew seats; pigeon-hole cases, desk; pulpits; refrigerators; rocker frames; rocker runners; rockers; shelves; showcases; sideboards; sofa frames; spring-bed frames; stands; table frames; table legs; table slides; tables; tables, billiard; tables, communion; tables, extension; tables, kitchen; tables, library; tables, parlor; wall cases; wardrobes.

Handles.—Handles; handles, cant-hook; handles, crosscut saw; handles, peavy; pike poles.

Instruments, musical.—Banjo necks; binders, piano backs; organs; piano backs; piano benches; piano bridges; piano posts; piano stools.

Insulator pins and brackets.—Insulator pins.

Laundry appliances.—Ironing boards; wash benches; washboards; washing machine dashers; washing machine parts.

Machine construction.—Folding machines; hose menders; machinery construction; power pump skids; roll paper cutters.

Machinery and apparatus, electrical.—Apparatus parts, electric; telephone accessories; telephone apparatus.

Patterns and flasks.—Flasks; flasks, foundry.

Planing-mill products.—Beams; finish; flooring; floors, cellar; interior finish; molding; sheathing.

Printing material.—Cases; printers' cabinets.

Pulleys and conveyors.—Pulleys; packing strips.

Pumps.—Buckets, pump.

Saddles and harness.—Cantles, saddletrees; hames; horse pokes.

Sash and doors.—Grain doors.

Ship and boat building.—Boat ribs; boats; boats, motor; boats, row; canoe-boat bottom boards.

Signs and supplies.—Signboards; signs, advertising.

Slack cooperage.—Headings; head linings; hoops; staves.

Sporting and athletic goods.—Tennis frame throats; billiard tables.

Tanks and silos.—Silo rims.

Toys.—Furniture, toy; sleds, toy.

Trunks and vehicle parts.—Automobile bodies; automobile-body framework; automobile body seat frames; automobile bows; automobile doors; automobile dusters, automobile floor boards; automobile running boards; bentwork; carriages and automobiles; bob sleds; buggy bows; buggy cushion frames; buggy hubs; cart trees; cutter bodies; cutter frames; doubletrees; eveners; eveners, wagon; go-cart rods; handles, cart; hubs, vehicle; hubs, wagon; hubs, wheelbarrow; rims, bicycle; singletrees; sled beams; sled runners; sleds, hand; sleds, mountain oscillator; sleigh runners; sleighs; spokes, wagon; stone boats; vehicle bodies; vehicle frames; wagon-bottom stock, wagon bows; wagon cleats; wagon repairing; wagon tongues; wheelbarrows.

Woodenware.—Bails, bucket and pail; barbers' checks; bushel measures; cheese boxes; coat hangers; game boards; hoops, bucket; hoops, woodenware; ironing boards; ladders; pails; pastry boards; pastry sets; plugs, paper roll; riddle rims; rungs, ladder; sieve rims; sieves, ash; sleeve boards; splints; traps, mouse; traps, rat; tubs.

SLIPPERY ELM.

Agricultural implements.—Compressers, hay balers'; doubletrees, plow and harrow; drill boxes; eveners; eveners, plow and harrow; harrow parts; hay baler parts; hay loader parts; hayrake parts; hoppers; machine handles; plow handles; seeder boxes, farm implements; vane slats, windmill; wheel slats, windmill.

Baskets and crates.—Baskets; box shooks; boxes; boxes, woven-wire; cases, egg; crates; crating; handles, basket; rims, basket.

Dairymen's and poulterer's supplies.—Butter-churn bows; butter-tub rims; stock racks.

Dowels.—Dowels.

Elevators.—Elevator platforms.

Equipment, playground.—Bent hammock spreaders; lawn swings.

Furniture and fixtures.—Buffets; church pews; fixtures; kitchen-cabinet shelving; kitchen cabinets; panels, veneered; refrigerators; rockers, chair.

Handles.—Handles.

Instruments, musical.—Banjo rims; piano backs; posts, piano backs.

Machine construction.—Engine skids; flour-mill machinery parts; gasoline-engine trucks; machine platforms, vender machines.

Pumps.—Sweeps.

Saddles and harness.—Neck yokes; ox yokes; saddletrees.

Slack cooperage.—Headings; hoops; staves.

Trunks and valises.—Trunks.

Vehicles and vehicle parts.—Bent panel backs, light vehicle; bentwork, carriage; hounds, vehicle; hubs; hubs, light vehicle; hubs, wagon; singletrees; sleigh runners; trucks, hand; wagon beds, coal; wagon reaches; whiffletrees.

Woodenware.—Game traps; ladders; ladders, store; lard tubs; mouse traps; rat traps; riddle rims; sieve frames; sieve rims; step chairs.

CORK ELM.

Agriculture implements.—Crossbars; doubletrees, plow and harrow; eveners; eveners, plow and harrow; feed cutters; grain boxes, corn planters; harrow parts; hay baler parts; hay-loader parts; hay racks; hayrakes; hoppers; hoppers, grain; machine handles; thrasher posts; wheat drill boxes.

Baskets and crates.—Baskets; baskets, vegetable; box shooks; boxes; boxes, cigar; boxes, packing; boxes, woven wire; cases, egg; crates; crating· hoops, basket; rims, basket.

Car construction.—Car construction; dump cars.

Dairymen's and poulterers' supplies.—Butter-tub rims; churns, butter.

Dowels.—Dowel rods; dowels.

Elevators.—Battens; beams, elevator cars; boxes, weight, dumb waiter; cleats, dumb waiter; elevator platforms; guide posts, dumb waiter; guide rails, dumb waiter; overhead beams, dumb waiter; shelves, dumb waiter.

Equipment playground.—Lawn swings.

Furniture and fixtures.—Buffets, inside work; chairs, wicker; kitchen cabinets; pews, church; posts, seat; rockers, chair; settees; settees, bent wood; tables, bent wood.

Handles.—Handles; handles, file; handles, machine; handles, snow shovel; scythe snaths.

Instruments, musical.—Piano cases.

Machine construction.—Engine skids; friction blocks, derrick; friction blocks, hoisting machine; gear parts, flour-mill machinery; grist mills; platforms; trucks, gasoline engine.

Machinery and apparatus, electrical.—Telephone pins.

Planing mill products.—Interior finish.

Printing material.—Printers' cabinets.

Pulleys and conveyors.—Cable rollers.

Saddles and harness.—Cantles; neck yokes; saddletrees; stirrups.

Ship and boat building.—Boats; launch-wheel drums; steering wheels.

Slack cooperage.—Headings; head linings; hoops; staves.

Sporting and athletic goods.—Horizontal bars.

Trunks and valises.—Sample cases; trunk slats; trunks.

Vehicles and vehicle parts.—Automobile bent seats; automobile body parts; automobile door pillars; automobile seats; baby carriages; bent frame backs; light vehicles; bent work; bob sleds; bows; buggy frames; cutter bodies; cutter frames; cutter runners; cutter stock; eveners; handcar frames; hand trucks; hounds, light vehicle; hounds, vehicle; hub blocks; hubs; hubs, carriage; hubs, light delivery wagon; hubs, light vehicle; push cars; railroad-velocipede handles; reaches; reaches, light vehicle; singletrees; sled knees; sled runners; sled runners, bent wood; sleds; sleigh bodies; sleigh runners; sleighs; spokes, wagon; truck rims; vehicle bodies; vehicle frames; wagon beds, wagon gears; wagon spokes; wagon tongues; wheel rims; wheel rims, automobile; wheelbarrows; whiffletrees.

Woodenware.—Bails, pail and bucket; chairs; step ladder; hoops, bucket; hoops, pail; hoops, woodenware; ladder rungs; ladders; lard tubs; mouse traps; sieve frames; sieve rims; sifter handles; stepladders; stools, stepladder; tent pins; tent slides; tubs, lard.

WING ELM.

Agricultural implements.—Agricultural implements (bent wood).

Baskets and crates.—Boxes; crates.

Furniture and fixtures.—Cabinet legs; bed slats.

Slack cooperage.—Staves; hoops.

Trunks and valises.—Suitcases; trunks.

Vehicles and vehicle parts.—Carriage shafts; wagon hubs; wagon poles.

Woodenware.—Hoops.

Saddles and harness.—Saddletrees.

ELM.

Agricultural implements.—Cradles; cradle bows; feed tables; grain drills; harvesters; hay racks; mower poles; reaper poles.

Baskets and crates.—Basket bottoms; basket covers; baskets; baskets, banana; baskets, fruit; baskets, grape; baskets, vegetable; boxes; boxes, cigar; bread-box slats; cases, egg; cases, fruit; crates, bushel; crates, fruit; crates, vegetable; crating; crating corners; crating posts; hoops, fruit package; hoops, vegetable package; package, fruit; package, vegetable; trays, grape.

Car construction.—Pullman-car repairing.

Caskets and coffins.—Coffins.

Dairymen's and poulterers' supplies.—Cheese-box heads; cheese-box hoops; coops.

Equipment, playground.—Croquet sets.

Furniture and fixtures.—Bed slats; bent work; cabinetwork; cabinets; camp furniture; chairs; chairs, children's; church furniture; couch frames; desks; drawer bottoms; fixtures; fixtures, store; framing, rattan furniture; furniture frames; refrigerators; rockers; seats, church pews; shelves, school desks; show-case bottoms; show-case panels; show-case tables; soda fountains; tables.

Gates and fencing.—Gates; fencing.

Handles.—Handles.

Instruments, musical.—Organs; panels, musical instruments; piano cases; piano parts; pianos; pipe organs; talking-machine horns.

Instruments, professional and scientific.—Tool chests.

Laundry appliances.—Laundry appliances.

Machine construction.—Horsepower; machine construction; paper-mill supplies.

Planing-mill products.—Finish; interior finish; planing-mill products.

Printing material.—Printers' supplies.

Pulleys and conveyors.—Conveyors; pulleys.

Sash and doors.—Sash.

Ship and boat building.—Barges; boat frames; boats; ship building; ships.

Sporting and athletic goods.—Sporting goods.

Toys.—Boys' sleds; boys' wagons; toys.

Trunks and valises.—Trunks.

Vehicles and vehicle parts.—Automobile bodies; axles; bows, bending; felloes; framing, baby carriage; hubs; sled; spokes; vehicle poles; wagons; wheel rims; wheelbarrows; whiffletrees.

Woodenware.—Grain measures; hoops; kegs; kits; oil-can jackets; pails; pails, tobacco; tubs; woodenware.

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